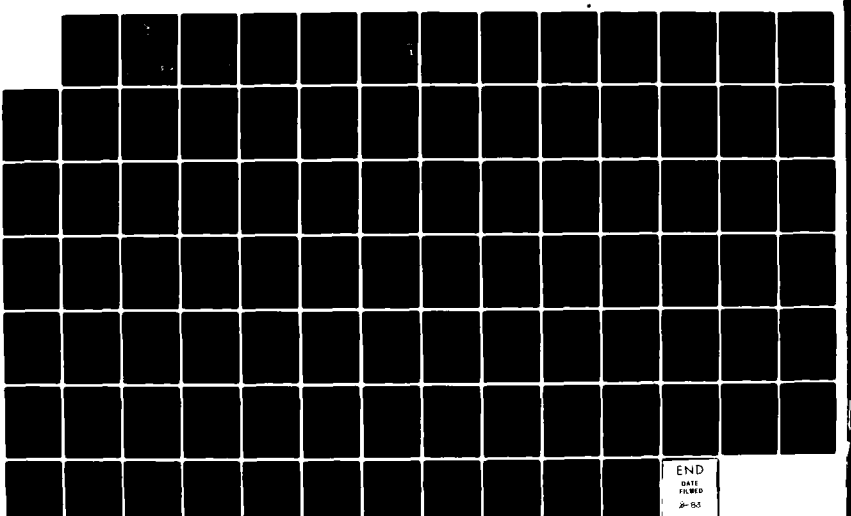
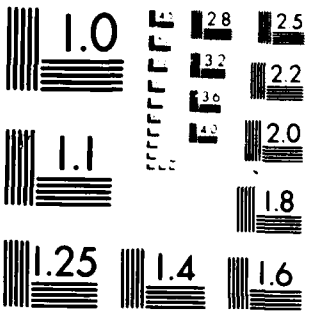
AD-A124 083 AN EVALUATION OF DATA PROCESSING GROWTH WITHIN THE AIR 1/1
STAFF(U) AIR FORCE INST OF TECH WRIGHT-PATTERSON AFB OH
SCHOOL OF SYSTEMS AND LOGISTICS L G RADOV ET AL.
UNCLASSIFIED SEP 82 AFIT-LSSR-9-82 F/G 9/2 NL



END
DATE FILMED
2-83
DTIC



This document has been approved for public release and sale; its distribution is unlimited.

DEPARTMENT OF THE AIR FORCE

AIR UNIVERSITY (ATC)

AIR FORCE INSTITUTE OF TECHNOLOGY

Wright-Patterson Air Force Base, Ohio

AN EVALUATION OF DATA PROCESSING GROWTH WITHIN THE AIR STAFF

Larry G. Radov, Captain, USAF
Stanley A. Sneegas, Captain, USAF

LSSR 9-82

The contents of the document are technically accurate, and no sensitive items, detrimental ideas, or deleterious information are contained therein. Furthermore, the views expressed in the document are those of the author(s) and do not necessarily reflect the views of the School of Systems and Logistics, the Air University, the Air Training Command, the United States Air Force, or the Department of Defense.

AFIT Control Number LSSR 9-82

AFIT RESEARCH ASSESSMENT

The purpose of this questionnaire is to determine the potential for current and future applications of AFIT thesis research. Please return completed questionnaires to: AFIT/LSH, Wright-Patterson AFB, Ohio 45433.

1. Did this research contribute to a current Air Force project?

   a. Yes b. No

2. Do you believe this research topic is significant enough that it would have been researched (or contracted) by your organization or another agency if AFIT had not researched it?

   a. Yes b. No

3. The benefits of AFIT research can often be expressed by the equivalent value that your agency received by virtue of AFIT performing the research. Can you estimate what this research would have cost if it had been accomplished under contract or if it had been done in-house in terms of manpower and/or dollars?

   a. Man-years _____ $ _____ (Contract).

   b. Man-years _____ $ _____ (In-house).

4. Often it is not possible to attach equivalent dollar values to research, although the results of the research may, in fact, be important. Whether or not you were able to establish an equivalent value for this research (3 above), what is your estimate of its significance?

   a. Highly Significant b. Significant c. Slightly Significant d. Of No Significance

5. Comments:

Name and Grade _____ Position _____

Organization _____ Location _____

FOLD DOWN ON OUTSIDE - SEAL WITH TAPE

AFIT/ LSH
WRIGHT-PATTERSON AFB OH 45433

OFFICIAL BUSINESS
PENALTY FOR PRIVATE USE, $300

NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES

BUSINESS REPLY MAIL
FIRST CLASS PERMIT NO. 73236 WASHINGTON D.C.

POSTAGE WILL BE PAID BY ADDRESSEE

AFIT/ DAA
Wright-Patterson AFB OH 45433

FOLD IN

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER LSSR 9-82	2. GOVT ACCESSION NO A124 082	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) AN EVALUATION OF DATA PROCESSING GROWTH WITHIN THE AIR STAFF		5. TYPE OF REPORT & PERIOD COVERED Master's thesis 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) Larry G. Radov, Captain, USAF Stanley A. Sneegas, Captain, USAF		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS School of Systems and Logistics Air Force Institute of Technology, WPAFB OH		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS Department of Communication and Humanities AFIT/LSH, WPAFB OH 45433		12. REPORT DATE September 1982 13. NUMBER OF PAGES 86
14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office)		15. SECURITY CLASS. (of this report) UNCLASSIFIED 15a. DECLASSIFICATION/DOWNGRADING SCHEDULE
16. DISTRIBUTION STATEMENT (of this Report) Approved for public release; distribution unlimited		
17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)		
18. SUPPLEMENTARY NOTES Lynn E. Wolaver LYNN E. WOLAVER Dean for Research and Professional Development APPROVED FOR PUBLIC RELEASE: IAW AFR 190-17 AIR FORCE INSTITUTE OF TECHNOLOGY (ATC) WRIGHT-PATTERSON AFB, OH 45433 26 OCT 1982		
19. KEY WORDS (Continue on reverse side if necessary and identify by block number) Automated Data Processing Data Processing Growth Models Air Staff Information Management Systems (ASIMS) Information Management Air Staff		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) Thesis Chairman: Ronald H. Rasch, Major, USAF		

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

The Air Staff is establishing an Air Staff Information Management System (ASIMS) to satisfy the expanding information requirements of the Air Staff and aid in problem-solving and decision-making. In order to properly implement ASIMS, an evaluation of the current data/information processing state at the Air Staff is necessary. Richard Nolan's theory on the data processing evolution within an organization contends that there are six distinct stages of data processing growth an organization evolves through and provides criteria for stage determination. This study finds that Nolan's theory can be modified for a military (nonprofit) organization. Using the data collected from Air Force budget documents and interviews, the Air Staff is moving into Nolan's Integration stage of data processing growth. The Air Staff is beginning to limit data duplication, and there is a shift in emphasis from managing the computer to managing the data/information resources. The results indicated the optimum organizational emphasis for the Air Staff to continue its data processing evolution is to encourage innovation and limit control of the data processing resources. By following the recommended organizational emphasis, the Air Staff can prepare itself to effectively use a system with the envisioned capabilities of ASIMS.

LSSR 9-82

AN EVALUATION OF DATA PROCESSING GROWTH WITHIN THE AIR STAFF

A Thesis

Presented to the Faculty of the School of Systems and Logistics

of the Air Force Institute of Technology

Air University

In Partial Fulfillment of the Requirements for the

Degree of Master of Science in Systems Management

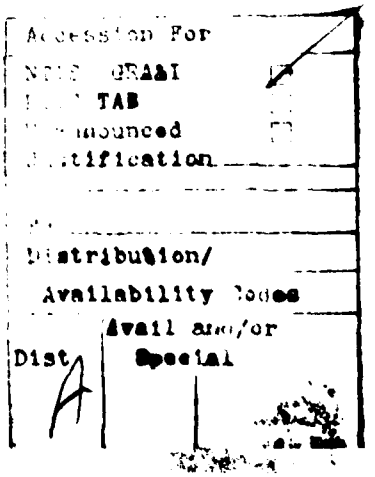
By

Larry G. Radov, BS
Captain, USAF

Stanley A. Sneegas, BS
Captain, USAF

September 1982

Approved for public release;
distribution unlimited



This thesis, written by

Captain Larry G. Radov

and

Captain Stanley A. Sneegas

has been accepted by the undersigned on behalf of the faculty of the School of Systems and Logistics in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE IN SYSTEMS MANAGEMENT

DATE: 29 September 1982

COMMITTEE CHAIRMAN

ACKNOWLEDGMENTS

We sincerely appreciate the many people who contributed to this research effort. Our advisor and chief mentor, Major Ronald H. Rasch, gave us invaluable guidance and direction. Lieutenant Colonel Arlyn D. Schumaker's cooperation and assistance enabled us to acquire the necessary data for this research. The Air Force personnel contacted at the Pentagon were most helpful and professional. We also acknowledge the special efforts of Suzanne Weber in typing this manuscript. Captain Sneegas gives a special acknowledgment to his wife, Barbara, for her love, understanding, and support.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1

INTRODUCTION

The management of computer data/information processing resources is undergoing a revolution in the 1980s. The emphasis on computer hardware and software is shifting toward a focus on information management, stressing the quality and the value of computer output rather than the quantity (25:3). The Federal Government and the Department of the Air Force, realizing the burden of excess paperwork, records management, and information sharing have initiated steps to improve the reliability and consistency of information used in decision-making and achieving goals. One product of the initiatives is the conceptualization of an Air Staff Information Management System (ASIMS) within the Department of the Air Force to serve the Air Staff and the Office of the Secretary of the Air Force (OSAF). The growth and development of ASIMS can benefit from the evolution of similar information management systems in other organizations.

The successful implementation of previous information management systems in corporations and non-profit organizations reflects a similar growth pattern in each organization (15:116). Experience has indicated that the organization and its members must develop and grow together to provide the most successful information management system. Until

organizational members understand the capabilities of the computer systems, management is concerned with managing the computer and its many potential uses. Once the successful management of the computer resources is accomplished, emphasis turns to the management of data/information resources. This transition is unique to every organization, but tends to follow an established cycle if the growth of the information management system is successful and ongoing (15:116).

Throughout this research effort the terms data and information may be used together or separately. There are a variety of definitions that attempt to describe the relationship between data and information.

> Data can be thought of as comprising any set of characters that is accepted as input to an information system and is stored and processed. Information refers to output of data processing that is organized and meaningful to the person who receives it [5:11].

Others refer to data as ". . . unrestricted, unevaluated facts having little or no meaning. It is only when data are applied to a specific problem (evaluated) that they become information [19:143]." Thus information is data evaluated for a particular problem, for a specific individual, at a certain time. Therefore, what may constitute information for one individual at a specific instance may not do so for another or even the same person at a different time (19:143). Often data and information are closely related; for this research the terms are used interchangeably.

Government and Air Force Initiatives in Information Management

The need for reliable, timely, and consistent information at all levels of government operations is essential in achieving federal goals (28:1). The information gathering process used by many federal agencies is inadequate for the demands placed on them. Estimates indicate that the public spends one billion hours each year completing forms generated by such agencies as the Internal Revenue Service and the Social Security Administration. Often different agencies need identical information from the public, but are unaware that another department already has the information on file. This mismanagement of data/information resources accounts for part of the $5 billion annual government computer work budget. Less than optimal use of information within the Department of Defense (DoD) is also gaining attention. At over $2 billion in 1980, the DoD computer use budget exceeds that of the largest American firms (11:54-56).

Concern with computer costs and growing demands on the public in the form of information reporting burdens and record keeping requirements resulted in the creation of the Commission on Federal Paperwork on 27 December 1974 (28:69), and later the Federal Data Processing Reorganization Project (FDPRP) by the Carter Administration (11:54). These two government initiatives revealed a great deal about the federal government's data gathering and information processing systems. These programs provided the impetus for the

continued attention given to the government's methods of managing information over the past six years. One outcome of the two programs is the conceptualization of an Air Staff Information Management System, which will incorporate many of the recommendations and new concepts of the Paperwork Commission and the FDPRP. The overall objective of ASIMS is to provide timely, accurate, and consistent information for Air Staff and Office of the Secretary of the Air Force problem solving and decision making (7:p. 1.1).

The FDPRP and the Commission on Federal Paperwork found many significant deficiencies in government information usage that ASIMS hopes to remedy at the Headquarters Air Force level. The FDPRP report disclosed that while the government developed the first successful, large-scale data processing installation in the early 50s, and pioneered the use of program languages in the 60s, the 70s saw the government equipment inventory generally become highly obsolescent, lagging behind comparable installations in private industry. The gap has grown so that the average age of all computer systems in the federal government is over seven years, while dramatic improvements in computer technology are occurring each year. The Federal Data Processing Reorganization Project also found that the federal government is mismanaging its information technology resources and has not developed a plan for examining future opportunities in information use. In addition, the FDPRP report claims that the military is operationally vulnerable as a result of obsolete equipment and

underdeveloped personnel (11:54-56).

The Federal Paperwork Commission also exposed similar tendencies to mismanage information in other government agencies. The Commission found that needed information is often not being collected, is not timely, or is not reliable; which limits the success of federal programs. The Commission's report, issued in September 1977, advocated the managing of information as a resource, so that data will be planned, budgeted, controlled, and evaluated adequately (29:40).

The Commission on Federal Paperwork is first credited with introducing the term Information Resources Management (IRM) as follows:

> The principles behind IRM encompass the idea that all media and technologies can be combined in a way that will optimize the productivity of the individuals in the organization, thereby optimizing the total information handling activities [13:24].

The studies done by the FDPRP and the Paperwork Commission laid the groundwork for the passage of Public Law 96-511, the Paperwork Reduction Act of 1980, signed by the President on 11 December 1980. The law first establishes an Office of Information and Regulatory Affairs under the Office of Management and Budget (OMB) with responsibility for all information management activities including information collection, statistical activities, records management, privacy of records, interagency sharing of information, automatic data processing, and telecommunications (11:56; 43:32). The law also creates the Federal Information Locator System (FILS) as a directory of government information resources, which can

be consulted by agencies before gathering information to insure the data has not already been collected (30:23-26). Each federal agency is required to designate a senior officer, who reports directly to the agency head, to carry out the responsibilities of information resources management,

> . . . including planning, budgeting, organizing, training, promoting, controlling, and other managerial activities involving the collection, use, and dissemination of information [43:32].

In carrying out the directives of the Paperwork Reduction Act, the Office of Information and Regulatory Affairs has tasked the Department of Defense and the Department of the Air Force to comply with the guidelines established by Public Law 96-511. Headquarters Air Force, through an Ad Hoc Planning Group and an Information Management Agency, has begun planning the future Air Force strategy for overall information management. The Air Force feels that the following goals, if pursued as long-range objectives, will improve the management of and use of information:

1. Treat data/information as a key organizational resource,
2. Identify the cost and burden of information requirements,
3. Improve the ability to answer questions and provide information for decision making,
4. Reduce the manhours and dollars required to process, manage, and use information,
5. Improve productivity, and
6. Get personnel thinking more about management of information (1:9-10).

The guidance originating with the President through

OMB and the Department of the Air Force has, in part, been responsible for the conceptualization of ASIMS. In addition, the expanded information requirements of the Air Staff have also generated an internal desire for better information management. The most significant Air Staff problems are substantial delays in responding to Congressional inquiries, conflicting answers often given to Congress, information saturation, and management frustration (20:4). The problem is so significant that various headquarters offices have begun initiatives to develop Deputy Chief of Staff or Directorate level Information Management Systems (7:1).

The combination of outside emphasis and the internal initiatives to improve the Air Staff management of information

> . . . have generated both the opportunity and obligation to provide sorely needed management information support while achieving real efficiencies and economies in information processing [7:1].

ASIMS is the Air Staff's plan for integrating all efforts to manage information as a key organizational resource. A Project Management Office (PMO) has been established on the Assistant Vice Chief's immediate staff for developing and executing the plan for implementation of ASIMS to serve both the Office of the Secretary of the Air Force (OSAF) and the Air Staff (7:1).

Statement of the Problem

The Air Staff Information Management System is needed for the Air Force to compete with other services to enhance

mission accomplishment. ASIMS will ameliorate several problems for the OSAF and the Air Staff when fully and properly implemented. The major problems include increasing response time to complete action items, providing conflicting information to Congress, and acquiring too much information. By implementing ASIMS the Air Staff hopes to achieve higher staff productivity, enhanced quality of work, improve timeliness, and a reduction in labor intensity. The additional benefits of ASIMS include cost avoidance through savings from more efficient management and increased efficiency in administrative support (20:4, 29).

The ASIMS Project Management Office has established the goals of a mature program as:

1. Assure timely, accurate, and consistent information is available for Air Staff and OSAF problem solving and decision making.
2. Incorporate the flexibility required to have the information system anticipate and survive organizational and management changes.
3. Be responsive to changing information needs in terms of data content, currency, format, media, and distribution.
4. Minimize unnecessary duplication.
5. Incorporate greater sharing of information through the employment of data standards, a data dictionary, data base management techniques, and telecommunications.
6. Facilitate interoperability among information systems.
7. Enhance the efficiency and economy of processing information.
8. Enhance the productivity of personnel who handle information.

9. Treat information as a key organizational resource (7:p. 1.1).

For an organization to meet and maintain the desired goals of ASIMS it must have an organizational design that will allow for effectiveness and efficiency. Although there is no best way to organize, different organizational designs provide for different levels of innovation and control (8:2; 2:557). In addition, as Richard L. Nolan has stressed in his model portraying the growth of the data/information processing organization, the properly timed management emphasis is essential to the successful evolution of the information management organization (15:116). The goals of ASIMS and the need for management direction and emphasis reveal one problem in the development of ASIMS. At this time there is not an existing organizational design to foster innovation and provide control for the proposed Air Staff Information Management System.

Objectives of the Research

This research effort concentrated on three primary objectives. Initially, using Richard Nolan's model on the evolutionary stages of data/information management growth, criteria were specified to evaluate a nonprofit military organization. Next, the applicable criteria were used to measure the overall Air Staff and its major divisions with respect to Nolan's six stages of data/information processing growth. The final objective was to analyze the results of the evaluations of the Air Staff as a whole and its major divisions to provide a basis for the specific organizational

design to be implemented in preparation for the adoption of ASIMS. Guidelines for the appropriate innovation and control characteristics are recommended for each subsequent stage of growth.

Scope

The establishment of ASIMS is unique to the Air Staff, and the specific results of this research may not be applicable to other organizations. The data gathered are from the major organizational units within the Air Staff and the OSAF.

Although this research centers on gathering data to determine the appropriate organizational design of ASIMS, several areas of this project may be relevant to other studies. Specifically, a better understanding of the stages of growth in a data/information processing organization as it relates to Nolan's stage theory can be gained from the research. In addition, the application of criteria to the six stages of growth for a military organization may be helpful in conducting future research in a similar environment.

CHAPTER 2

DATA PROCESSING GROWTH MODELS

Many organizations have experienced a rapid growth in data processing budgets, but have not recognized a similar growth in the productivity of these systems. The annual data/information processing budgets are exceeding growth rates of 30 percent. This increase per year is more than the total size of the budgets four to five years ago (15:116).

The most recent literature concerning the data processing function in organizations contends that data processing evolves through distinct stages of learning and growth. The growth pattern (reflected in data processing costs) follows that of an S-shaped curve. This curve has been used by Arnold Toynbee to explain the histories of societies, and by others to explain the success pattern or organizations, product development, market development, as well as life cycles of technologies (12:457; 24:46).

The following review discusses the stage theories that have evolved with respect to the growth of the data processing function. Cyrus F. Gibson and Richard L. Nolan first identified four stages of data processing growth. Others including Paul A. Strassman and Frederic G. Withington were to comment on and critique the four-stage theory, which influenced Nolan in expanding his four-stage concept to a six-stage growth pattern

that more accurately reflects present data processing growth in organizations.

The Four-Stage Growth Theory

In 1973 Richard Nolan, a former associate professor of business administration at the Harvard Business School, discovered that the data processing budgets for a number of companies, when plotted over time, forms an S-shaped curve that he referred to as the Data Processing Learning Curve (9:77). The changes in slope of this curve correspond to the significant events in the life of the data processing function that identify shifts in the way the computer resource is managed and used. There are three points where the S-shaped curve turns that depicts the natural break between the four stages that Nolan and Gibson first identified. The four stages depicted in Figure 1 -- Initiation, Expansion, Formalization, and Maturity -- are defined by the inflection points on the data processing learning curve (9:78).

As the data processing department matures, the organization evolves from one stage to the next. In Nolan's four-stage hypothesis, the growth takes place in three primary areas: 1) the portfolio of computer applications for each stage; 2) the personnel specialization required of the workers; and 3) the management techniques customarily applied in each of the four stages. Figure 2 describes the three areas of growth and further details the evolution as an organization moves from stage 1 to stage 4. For example, in stage 1 with

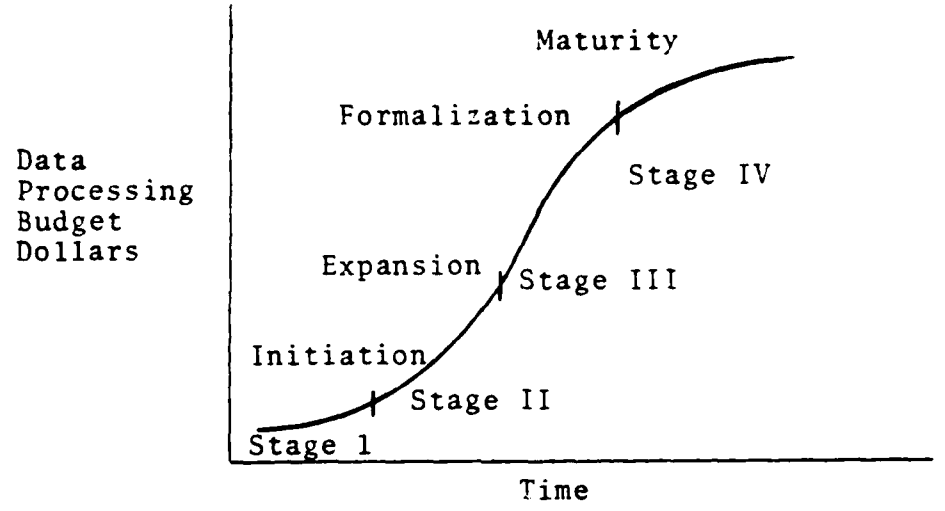


Fig 1. Data Processing Learning Curve
(24:47)

computer applications, the introduction of data processing equipment to reduce costs where manual accounting operations take place, will result in lower expenses for maintaining payroll, cash flow, and billing accounts.

In their article, Gibson and Nolan warned that there may be more S curves as new technologies emerge, and as organizations become more aggressive in using data processing techniques and more sophisticated in systems analysis (9:77). Two other information system specialists made contributions on the evolution of data processing that were to influence Nolan in his later articles. Paul Strassman, of Xerox Corporation, first pointed out that inflation can influence the S-shaped curves that represent the data processing costs of an organization over time. Inflation guarantees that labor

STAGE I	STAGE II	STAGE III	STAGE IV
Cost Reduction-Accounting	Proliferation In All Functions	Emphasis On Control	Data Base Applications
Payroll	Cash	Project Control	Simulations
Receivables	Ledger	Cost Analysis	Planning
Payables	Budgets	Chargeouts	On-Line Inquiry
Billing	Inventory	Scheduling	On-Line Order Entry
	Personnel		
	Orders		
	Sales		
	Production		

a) Growth of Applications

STAGE I	STAGE II	STAGE III	STAGE IV
General Specialization	Applications Specialization	Control Specialization	Data Base Specialization
Operator	Systems Programmer	Development Programmer	Data Base Programmer
Programmer	Scientific Programmer	Maintenance Programmer	Teleprocessing Programmer
			Operations Systems Programmer
Analyst	Business Programmer	Functional Analyst	Data Base Manager

b) Growth of Personnel Specialization

STAGE I	STAGE II	STAGE III	STAGE IV
Lax Management	Promotional Management	Control Management	Resources Management
In Accounting	In Finance Systems Analysis Decentralized	Independent Function Steering Committee	Independent Unit Systems & Programming Decentralized
Control Lacking	Lax Control Few Standards Informal Project Control	Standards Price Control Chargeouts; Audits; Operate Controls	Chargeouts Services Pricing Design Control
Loose Budgets	Loose Budgets	Strong Budgets	Long-Range Planning

c) Management Techniques Applied to Each Stage

Fig 2. Three Areas of Growth (24:47)

costs, which may represent 50 to 70 percent of the budget, will increase with time. Strassman contends cost/benefit ratios, or a similar method of determining project profitability, provides the best indicator of the desirability of new data processing projects (24:48).

Another data processing consultant was to influence Nolan by explaining the evolution of data/information processing as an ongoing process. Frederic Withington proposed five generations of computers that reflect the evolutionary process of computers as being essentially technology-driven. Withington states that the current technology will drive the new applications to be accepted and the type of organizational structure adopted for managing the data processing system (42:100). Table I depicts Withington's five generations of computers and how the hardware, computer functions, and organization will evolve over time.

The Six-Stage Growth Theory

Nolan continued to study organizations, applying his four-stage theory to various corporations. As a result of his research and inputs from Strassman and Withington, Nolan expanded his data processing growth theory to six stages. Fundamental in the expansion was the development of data base technology. The data base technology costs represent another S-shaped curve to combine with the overall data processing learning curve (12:457; 24:49). The assimilation of the data base technology is depicted in Figure 3, which reflects the

TABLE I

Withington's Five Generations
(24:47)

	Hardware	Functions	Organization
Stage I 1953-1958	Vacuum tubes	Experimental Batch	Controller's Department
Stage II 1958-1966	Transistors	Full Range	Proliferation
Stage III 1966-1974	Large-scale Integrated Circuits	Networking Remote Job Entry	Consolidation, with terminals
Stage IV 1974-1982	Large Files Satellite Computers	Integrated Files Transaction Processing	Satellite Processing
Stage V 1982-?	Distributed Systems Exotic Memories	Private Information Simulation	Interconnected networks to all parts of organization

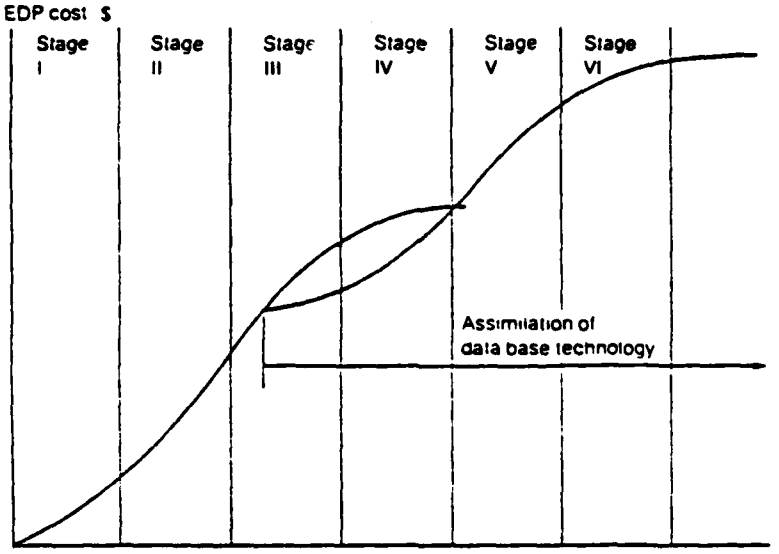


Fig 3. Growth Curves Postulated by Nolan
(24:458)

addition of two stages to the growth theory.

As a basis for the six-stage growth theory, Nolan isolated four growth processes that determine the current stage of evolution for an organization. An explanation of the four growth processes that Nolan monitors follows:

1. The portfolio of computer applications. The programs and procedures which are used by the organization in its business activities. The applications portfolio represents the cumulative end product of the data processing organization.

2. The data processing organization and technical capabilities. The organization structures and technical capabilities found within the data processing department which are required to develop and operate application systems. These include data processing management structure, hardware and software resources, systems development and operations organizations.

3. Data processing planning and management control systems. The set of organization practices used to direct, coordinate and control those involved in the development and operation of application systems, including data processing planning, project management, top management steering committees, chargeout and performance measurement.

4. The user. The members of line and staff departments who must use the applications systems to perform their jobs [14:9].

According to Nolan, the four growth processes help to provide unique characteristics for each of the six stages of data processing growth. The stages and a brief explanation of their characteristics follow:

1. Initiation - computer technology is introduced and applied to high-volume, high-payoff areas such as accounting.

2. Contagion - computer applications proliferate in functional areas throughout the organization so employees may realize what the computer can do.

3. Control - new computer applications are restricted, and the emphasis shifts to documenting and improving existing applications and the development of formalized systems for planning and controlling the computer resource.

4. Integration - limit data duplication by storing it in one place. Data base technology is introduced and existing applications are modified to utilize this new technology. There is a shift in emphasis from managing the computer to managing the company's data resources.

5. Data Administration - data base technology is used to integrate existing applications on an increasingly wider scale, and the functional manager must implement control.

6. Maturity - the applications portfolio is complete, and it matches the organization and information flows in the company. Maturity takes place (5:298-299; 18).

By combining the explanations of the six stages and the four areas where data processing growth takes place into a single figure, an example of an organization's evolution is depicted. Figure 4 represents a typical organization's transition through the six stages of growth. The dotted line represents the organization's level of expenditures (S-shaped curve) from the introduction of the computer into the organization to the mature management of information resources. Until mid-stage 3, management is concerned with managing the computer. "At some point in stage 3, there is a transition to management of data resources [15:116]." This transition not only involves restructuring the information processing organization, but also includes installing new management techniques.

The techniques used by management play an important role in the organizational learning and growth that takes

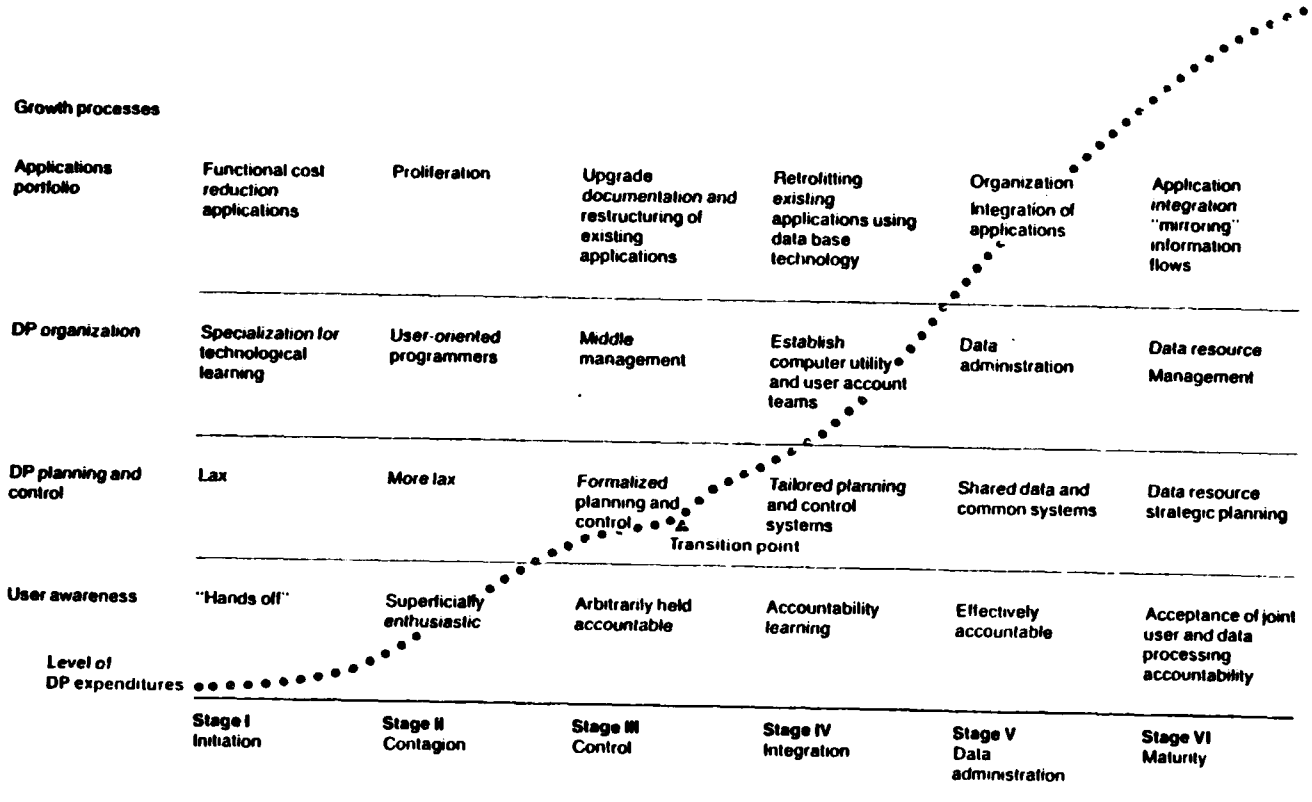


Fig 4. Six Stages of Data Processing Growth (15:117)

place. Management must provide an environment in which the appropriate learning can take place for the organization to progress from stage to stage. Nolan refers to two environments which will guide an organization in its growth. One environment is called "control," and the other is called organizational "slack," (6:53-55) which will be referred to as organizational "innovation."

> In the control environment, all financial and performance management systems - including planning, budgeting, project management, personnel performance reviews, and chargeout or cost accounting systems - are used to ensure that . . . [15:116]

data/information processing activities are effective and efficient. In the innovation environment, though, sophisticated controls are absent and there are incentives to use information processing techniques in an experimental manner. As an example, systems analysts might be assigned to users without any charge to the users' budgets. By creating the innovation type environment, costs will be higher, but the birth of new ideas will take place that are necessary for growth of the organization (15:117).

The trade-off between control and innovation is critical in developing an appropriate management emphasis for each stage of organizational learning. For instance, an imbalance of high control and low innovation in the earlier stages can impede the use of information technology in the organization. On the other hand, an imbalance of low control and high innovation in later stages can lead to explosive information processing budget increases and inefficient systems (15:117).

TABLE II

Optimum Balance of Organizational Innovation and Control (15:118)

	Organizational Innovation		Organizational Control		Objectives of Control Systems
	Computer	Data	Computer	Data	
Stage 1	Low		Low		
Stage 2	High		Low		Facilitate Growth
Stage 3	Low	Low	High	Low	Contain Supply
Stage 4		High		Low	Match Supply and Demand
Stage 5		Low		High	Contain Demand
Stage 6		High		High	Balance Supply and Demand

Table II demonstrates the appropriate balance of control and innovation to use through Nolan's six stages of growth. Notice that the emphasis of management shifts from management of the computer to management of data resources. This shift is associated with the introduction of data base technology and explains the absence of entries in the computer columns after stage 3.

Models such as the one developed by Richard Nolan may be of use to the Air Staff for determining the appropriate management emphasis requisite in the organizational design of ASIMS. The objectives of the control systems are to influence the supply and demand of data processing applications. For

example, the objective of stage 3 growth is to contain or restrict the supply of automated applications.

CHAPTER 3

METHODOLOGY

The methodology used to meet the research objectives is discussed in this chapter. Nolan's six criteria for specifying the stage of data processing growth for a nonprofit organization are described and then applied to the Air Staff. Next, the method for determining the current Air Staff growth stage is presented. Finally, the options for organizational emphasis are discussed.

Criteria

Nolan proposes a six-stage growth process for data processing management. Six criteria, or benchmarks, differentiate the various stages of growth. The six criteria are expenditure ratios, level of technology, types of computer applications or the applications portfolio, data processing organization, planning and control, and amount of user awareness. The six criteria are divided into two levels of analysis. The first two criteria comprise the first level of analysis and evaluate the stage of growth for the organization as a whole. The second level of analysis, consisting of the last four criteria, evaluates the growth stage for each division within the organization (15:121).

First Level of Analysis. The initial criteria for this

level of analysis is the expenditure ratio for data processing. Nolan recommends calculating the ratio of data processing costs to total sales. As mentioned in Chapter 2, Strassman first suggested some type of cost/benefit ratio be used to measure actual data processing growth. The use of a ratio reduces the effects of inflation that are found when a single figure such as the data processing budget is used to determine real growth (24:48).

When Nolan developed his growth stage theories in the 1970s, he studied 50 profit-making organizations. His cost/benefit ratio compared data processing costs to total sales. In contrast, this research effort concerns the Headquarters of the United States Air Force, a nonprofit organization. Consequently, sales cannot be used as an appropriate denominator for the expenditure ratio criteria. Following from Strassman's conclusions, a benefit or output must be determined for the nonprofit organization to calculate an expenditure ratio for Nolan's first level of analysis. Anthony and Herzlinger, in their book Management Control In Nonprofit Organizations, state that it is difficult to measure the output of a nonprofit organization, and even in profit organizations revenue is rarely a complete expression of outputs (3:6). The two authors go on to say, ". . . outputs should equal inputs [3:39]" in nonprofit organizations and that inputs can be an acceptable measure of outputs (3:249). In addition, economists contend that the benefit of national defense should be valued at cost, hence the budget (26:44). Therefore,

this analysis uses the ratio of the Air Staff data processing budget to the total Air Staff budget to determine Nolan's expenditure ratio for the first level of analysis. If the expenditure ratio is constant over time, then the Air Staff is in stage 1, Initiation, or stage 6, Maturity. If the ratio is increasing over time, then the Air Staff is in stage 2, Contagion, or stage 4, Integration. If the ratio is decreasing over time, then the Air Staff is in stage 3, Control, or stage 5, Data Administration. Consequently, the first criteria will narrow the Air Staff's stage of growth down from any of the six to two stages (15:121).

The second criteria, level of technology, is the final element in the first level of analysis. Technology examines the type and percentage of different processing techniques within the Air Staff. The level of technology within the Air Staff will approximate one of the six criteria in Figure 5. The combination of the first and second criteria complete the first level of analysis. Both criteria offer an indication of the overall range of the various Air Staff organizational units in terms of data/information growth.

Second Level of Analysis. The second level of analysis defines the growth stages for each of the Air Staff organizational units analyzed in this research (see Table III). All of the second level criteria were not applicable to each unit. For example, each section did not have a data processing organization, in which case that particular criteria was not evaluated for the unit. After applying each criteria in the

Expenditure Benchmarks	Tracks Rate of Budget Growth	Exceeds Rate of Budget Growth	Is Less Than Rate of Budget Growth	Exceeds Rate of Budget Growth	Is Less Than Rate of Budget Growth	Tracks Rate of Budget Growth
Technology benchmarks	100% batch processing	80% batch processing 20% remote job entry processing	70% batch processing 15% data base processing 10% inquiry processing 5% time-sharing processing	50% batch & remote job entry processing 40% data base & data communications processing 5% personal computing 5% minicomputer and microcomputer processing	20% batch & remote job entry processing 60% data base & data communications processing 5% personal computing 15% minicomputer and microcomputer processing	10% batch & remote job entry processing 60% data base & data communications processing 5% personal computing 25% minicomputer and microcomputer processing
	Stage 1 Initiation	Stage 1 Contagion	Stage 3 Control	Stage 4 Integration	Stage 5 Data Administration	Stage 6 Maturity

Fig 5. Criteria for First Level of Analysis (15:121)

TABLE III

Department of the Air Force Organizational Units
(41:1)

Acronym	Full Name
OSAF	Office of the Secretary of the Air Force
AC	Comptroller of the Air Force
NGB	Chief of the National Guard Bureau
DA	Director of Administration
HC	Chief of Chaplains
IG	Inspector General
IN	Assistant Chief of Staff, Intelligence
JA	Judge Advocate General
LE	DCS/Logistics and Engineering
MP	DCS/Manpower and Personnel
NB	USAF Scientific Advisory Board
PR	DCS/Programs and Resources
RD	DCS/Research, Development and Acquisition
RE	Chief of the Air Force Reserve
SA	Assistant Chief of Staff, Studies and Analysis
XO	DCS/Plans and Operations
1947th	1947th Air Staff Administrative Support Group
DSC	Air Force Data Services Center

second level of analysis to the various units within the Air Staff, a range of growth in the Air Staff was determined. The criteria for the second level of analysis is depicted in Figure 6.

The growth stage for the applications portfolio criteria reflects the types of applications used in each unit (25:101). In general, the organizational unit is in stage 1 to 2 if ". . . there is a concentration on labor-intensive

Applications portfolio.	There is a concentration on labor-intensive automation, scientific support, and clerical replacement.	Applications move out to user locations for data generation and data use.	Balance is established between centralized shared data/common system applications and decentralized user-controlled applications.
DP organization.	Data processing is centralized and operates as a "closed shop."	Data processing becomes data custodian. Computer utility established and achieves reliability	There is organizational implementation of the data resource management concept. There are layers of responsibility for data processing at appropriate organizational levels
***DP planning* and control.**	*Internal planning and control is installed to manage* the computer. Included are standards for programming, responsibility accounting, and project management.	*External planning and control is installed to manage* data resources. Included are value-added user chargeback, steering committee, and data administration.	
User awareness.	Reactive: End user is superficially involved. The computer provides more, better, and faster information than manual techniques.	Driving force: End user is directly involved with data entry and data use. End user is accountable for data quality and for value-added end use	Participatory: End user and data processing are jointly accountable for data quality and for effective design of value added applications

Stage 1 Initiation	Stage 2 Contagion	Stage 3 Control	Stage 4 Integration	Stage 5 Data administration	Stage 6 Maturity

Fig 6. Criteria for Second Level of Analysis (15:121)

automation, scientific support, and clerical replacement [15: 121]." If the applications are located with the user for data generation and use, then the unit is in stage 3 or 4. If a balance is achieved with decentralized user applications and centralized data bases and common systems, then the unit is in stage 5 or 6 (15:121).

The data processing organization criteria differentiates the units into groups that include two stages of growth. If the processing function is a centralized "closed shop," the unit is in stage 1 or 2. If the processing function is merely a data custodian and the outputs are useful and reliable, then the unit is in stage 3 or 4. If the organizational unit has accepted the data/information resource concept and responsibility for processing is appropriately dispersed, then the unit is in stage 5 or 6 (15:121).

The data processing planning and control criteria differentiates between stages 1 through 3 and 4 through 6. If internal planning and control is focused on the computer with ". . . standards for programming, responsibility accounting, and project management [15:121]," then the unit is in one of the first three stages of growth. If the unit's external planning and control is focused on data/information resource management with ". . . value-added user chargeback, a steering committee, and data administration [15:121]." then the unit is in the last three stages.

The final criteria, user awareness, is more definitive than planning and control. If the user restricts his knowledge

and use of automated systems to replace existing manual processes, then the unit is in stage 1 or 2. If the users within the unit are responsible for data entry, use, and quality, then the unit is in stage 3 or 4. If the unit end users and the data/information processing organization are jointly responsible for the data/information entry, quality, and applications, then the unit has entered stages 5 and 6 (15:121).

All four of these criteria were combined for each unit before assigning the unit to a given overall stage. Any one of the criteria might overlap several stages. Therefore, the most complete assessment considered all four criteria.

Stage Determination Process

The data collected determined the degree to which the Air Staff and each of its units met the criteria for stage determination. When compared against the criteria, the data collected for expenditure ratios and level of technology gave the results for the first level of analysis. This data determined the growth stage of the Air Staff as a whole.

All four second level criteria specified the stage of growth for the separate Air Staff units. Each criteria had equal weight in stage determination. Since the data collected for the second level of analysis is ordinal data, when a unit falls into a certain stage it must not be compared to other units in that stage of growth (23:38-40). In other words, once an Air Staff unit is designated in a stage of growth for

a specific criteria, that unit is equal to all other units in that stage due to the nature of the data. Values were assigned for the stage of each criteria and then divided by the number of criteria used to determine each unit's overall stage of growth as depicted in Table IV.

TABLE IV

Example Evaluation

Unit	Stages for a Given Criteria				
	Applications Portfolio	DP Organization	DP Planning & Control	User Awareness	Overall Unit Growth Stage
Air Staff Unit	3.5	1.5	2.0	3.5	2.685

Notice that when a specific criteria covers more than one stage, the value associated with that range is the midpoint of the stages, such as 3.5 for the applications portfolio criteria for the example in Table IV. According to Nolan's model, each second level analysis criteria is considered equal in weight, allowing for a mean value of the criteria to be used in determining the overall stage of growth for each Air Staff organizational unit.

Following the individual unit analysis, a summary table was made for all Air Staff units. The stage of growth range for all units provided a basis for determining the type of organizational design to be used when implementing ASIMS and will indicate less developed units that need increased attention. The combination of the first level and second

level analysis provides an Air Staff-wide profile of its data processing growth stages.

Organizational Emphasis

Knowledge of the growth stage determines the appropriate organizational design to be used in implementing ASIMS. The desired organizational design will apply the needed innovation and control to promote the growth of data/information processing within the Air Staff. The optimum relationship for each stage was shown in Table II. By combining the results in the summary table and the guidance in Table II, the ASIMS management can apply the appropriate emphasis in terms of innovation and control for the individual units. As the growth of data processing continues, the organizational emphasis can be adjusted accordingly.

CHAPTER 4

DATA COLLECTION

The quality of any analysis is a function of the quality of its data. The data for this research were obtained from several authoritative sources in the Pentagon. The organizations which provided data relevant to the Air Staff were the Air Force Data Services Center (AFDSC), the 1947th Support Group, and the ASIMS Working Groups. The AFDSC, a part of the Air Force Communications Command, is responsible for providing data processing support to the Air Staff and the OSAF. The 1947th Support Group provides administrative support to the Air Staff and the OSAF. The two ASIMS Working Groups are the Advisory Group (AG) and the Information Systems Architecture (ISA) Working Group. The AG is composed of senior personnel who have ". . . a broad knowledge and understanding of the information system requirements of the functional office they are representing [7:22]." The ISA Working Group members develop detailed analysis ". . . needed to support the functional and staff mission of their respective organizations [7:22]." Most of the data was obtained in Air Force budget publications (20; 21; 32; 33; 34; 35; 36; 37; 38; 39; 40) and through interviews (4; 10; 16; 17; 22; 27) coordinated with Lt. Col. Arlyn D. Schumaker at the Pentagon from 14-17 June 1982.

Data for First Level of Analysis

The first level of analysis requires budget and level of technology data. The Air Staff data processing budget (Table V) and total Air Staff budget (Table VI) data were provided by Gilbert (10) and Payne (16), respectively.

TABLE V

Air Staff Data Processing Budget
(10)

Fiscal Year	Budget ($ in thousands)
1977	16,043
1978	23,628
1979	19,951
1980	21,658
1981	29,609
1982*	35,888
1983*	46,753
* Estimates	

TABLE VI

Total Air Staff Budget
(16)

Fiscal Year	Budget ($ in thousands)
1977	128,751
1978	129,161
1979	115,890
1980	123,557
1981	149,471
1982*	168,205
1983*	181,799
* Estimates	

Gilbert monitors the Air Staff data processing budget and he compiled the data by using the President's Budget: ADP Cost Summary and Justification of Estimates budget documents. Excerpts of these budget documents are presented in Appendices B and C. Payne compiled all elements for the entire Air Staff budget using procurement, operations and maintenance, and personnel budgets (16).

The level of technology data (Figure 7) was collected during three interviews. The interviews were conducted with the ASIMS Interview Guide/Questionnaire (Appendix A). Question 1 was used to determine the level of technology benchmark. The question asked each respondent to ma ch the Air Staff level of technology with one of Nolan's six stage descriptions. Mr. Petroski (17) and Lt. Col. Tufts (27) stated the Air Staff most closely matched stage 4. Lt. Col. Caswell (4) stated the Air Staff represented stage 4 moving to stage 5. Mr. Petroski is responsible for managing the AFDSC computer systems. Lt. Col. Tufts manages the applications programs for the Air Staff budget and financial systems. Lt. Col. Caswell is responsible for all other Air Staff applications programs. The four remaining questions relate

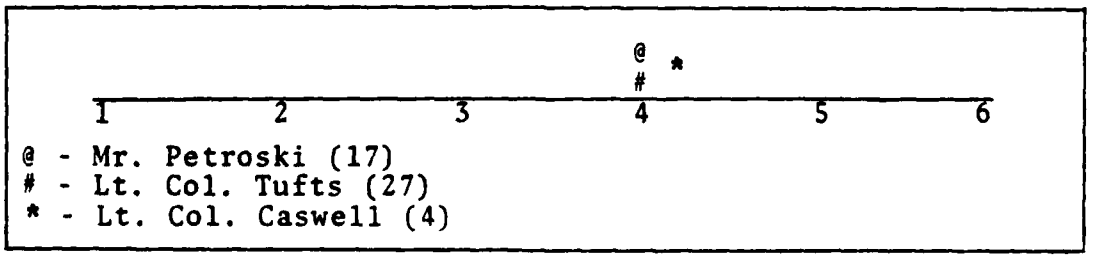


Fig 7. Air Staff Level of Technology

to the four growth processes in Nolan's second level of analysis.

Data for the Second Level of Analysis

The ASIMS Advisory Group and ISA Working Group responses to Questions 2 through 5 are summarized in Table VII. Questions 2, 3, and 5 asked each respondent to match their organizational unit's application portfolio, data processing organization, and user awareness with one of Nolan's three respective descriptions from Figure 6. Question 4 asked each respondent to match their organizational unit's data processing planning and control with one of Nolan's two descriptions from Figure 6. The wording of the responses conforms to Nolan's descriptions to avoid undue bias. Consequently, each response will be an average of two or three stages. Therefore, an "A" response to Questions 2, 3, and 5 will be the average of stages 1 and 2, or 1.5. Likewise a "B" response is 3.5, and a "C" response is 5.5. Question 4 responses of "A" and "B" translate to 2 and 5, respectively. The loss of precision by using the average is not the only data limitation.

Data Limitations

The budget data for the first level of analysis was limited to seven years. Prior budget data was located in the Air Force Archives, and not accessible within the time constraints of the research project. The older the data source, the more difficult it was for the budget specialists to insure the data was composed of common inputs due to changing

TABLE VII

Air Staff Interview/Questionnaire Responses

Respondent	Unit	Question Number			
		2	3	4	5
1	ACM	A	B	B	B
2	ACM	A	B	B	B
3	DA	C	C	B	C
4	DA	C	C	B	C
5	HC	A	A	A	B
6	HC	A	A	A	B
7	IG	NO DP Stage 1			
8	IN	B	A	A	C
9	IN	A	B	A	A
10	JA	A	B	B	C
11	LE	C	C	B	C
12	LE	A	-	-	B
13	MP	C	C	A	B
14	MP	B	B	A	C
15	NB	A	-	-	A
16	PR	B	C	A	B
17	PR	B	A	A	C
18	RD	A	B	A	A
19	RE	C	B	A	B
20	SA	A	C	A	B
21	SA	A	C	A	B
22	XO	B	B	A	B
23	XO	B	B	A	B
24	NGB	B	A	A	B
25	NGB	B	B	A	A
26	1947	B	C	A	C
27	AFDSC	B	B	A	A
28	AFDSC	B	B	A	C
29	OSAF	B	-	-	C

accounting policies and new administrations (10:16).

The validity of the second level of analysis is dependent upon the level of experience and knowledge of the respondents. The Comptroller of the Air Force (AC) respondents based their comments upon the Cost and Management Analysis Division (ACM) only. Consequently, the researchers were unable to get responses from two heavy data processing users, the Computer Resources and Budget Divisions in AC. Most

organizations have two representatives who responded independently. However, some organizations may have only one representative in the ASIMS group or only one who responded independently.

CHAPTER 5

DATA ANALYSIS

This chapter analyzes the data collected during the research visit to the Pentagon. The first level of analysis is presented and followed by the second level analysis. The results of both analyses, with respect to Nolan's growth theory, provides the guidelines for determining the organizational emphasis to be employed at the Air Staff, which is the final element of this chapter.

First Level of Analysis

The first level of analysis is comprised of the expenditure and technology benchmarks (criteria) as described in Figure 5. The expenditure ratio benchmark is calculated from the ratio of the budget data in Tables V and VI for the seven years of data available. The ratios and the change from year to year are reflected in Table VIII.

Another representation of the expenditure ratio is depicted in Figure 8, which symbolizes the S-shaped curve discussed in Chapter 2. Assuming a constant rate of inflation for both the data processing budget and the total Air Staff budget, the resulting change in the ratios from year to year represents the real growth in the data processing budget. The expenditure ratio graph shows a rise in the data processing

TABLE VIII

Air Staff Expenditure Ratios

FY	Ratio	Year-to-Year Change
1977	.1246	
1978	.1829	+.0583
1979	.1722	-.0107
1980	.1753	+.0031
1981	.1981	+.0228
1982*	.2134	+.0153
1983*	.2572	+.0438

* Estimates

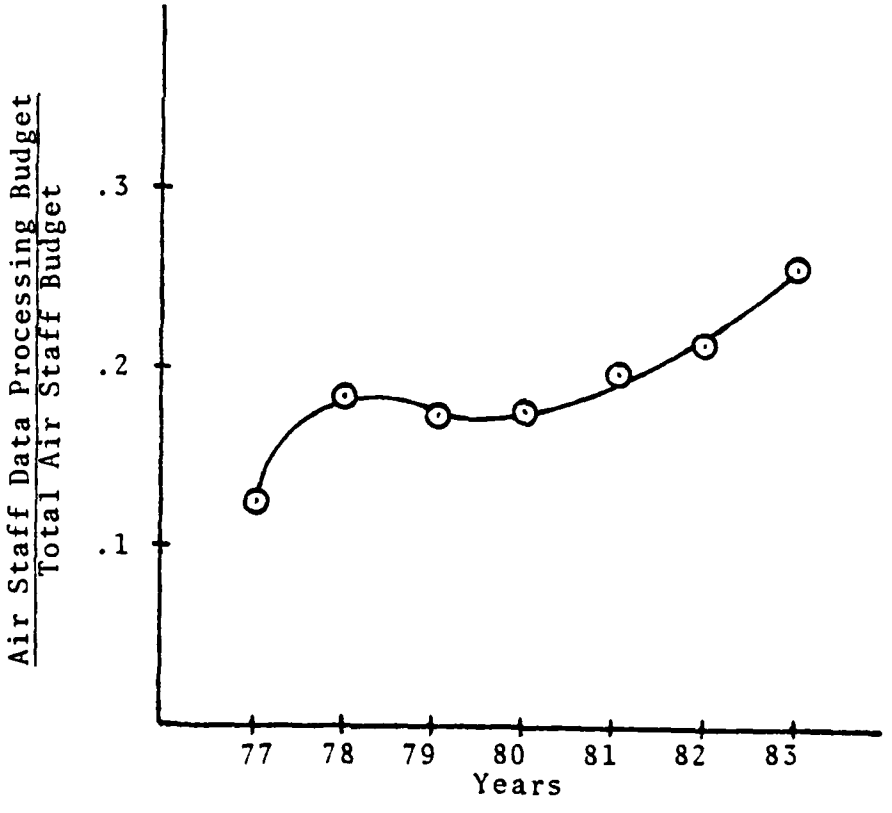


Fig 8. Changes in Expenditure Ratios

expenditures relative to the total Air Staff budget. The increase in the data processing budget relative to the overall budget indicates that the Air Staff is in stage 2 or stage 4 for the expenditure ratio benchmark of Nolan's growth theory.

The second criteria or benchmark in the first level of analysis is the determination of the existing technology within the Air Staff and the OSAF where ASIMS will be introduced. A similar response was received from the three computer managers interviewed at the Air Staff. As shown in Figure 7, the experts agree that the existing equipment usage is best reflected by that found in stage 4. Nolan describes stage 4 technology as:

- 50 percent batch and remote job entry processing
- 40 percent data base and data communications processing
- 5 percent personal computing
- 5 percent minicomputer and microcomputer processing

Combining the results from the two criteria in the first level of analysis, the Nolan data processing stage of growth that currently best represents the Air Staff and the OSAF is stage 4, Integration. The Integration stage is characterized by a shift in emphasis from managing the computer to managing data resources. Data base technology is introduced and existing applications are modified to utilize this new technology. Stage 4 best describes the Air Staff as a whole at this time, and determines the organizational emphasis to apply in terms of control and innovation.

TABLE IX

Second Level of Analysis Evaluation Summary

Unit	Applica-tions Portfolio	DP Organi-zation	DP Plan-ning & Control	User Aware-ness	Overall Unit Growth Stage
ACM	1.5	3.5	5	3.5	
ACM	1.5	3.5	5	3.5	3.375
DA	5.5	5.5	5	5.5	
DA	5.5	5.5	5	5.5	5.375
HC	1.5	1.5	2	1.5	
HC	1.5	1.5	2	1.5	1.625
IG	1.0	1.0	1	1.0	1.000
IN	3.5	1.5	2	5.5	
IN	1.5	3.5	2	1.5	2.625
JA	1.5	3.5	5	5.5	3.875
LE	5.5	5.5	5	5.5	
LE	1.5	-	-	3.5	3.927
MP	5.5	5.5	2	3.5	
MP	3.5	3.5	2	5.5	3.875
NB	1.5	-	-	1.5	1.500
PR	3.5	5.5	2	3.5	
PR	3.5	1.5	2	5.5	3.375
RD	1.5	3.5	2	1.5	2.125
RE	5.5	3.5	2	3.5	3.625
SA	1.5	5.5	2	3.5	
SA	1.5	5.5	2	3.5	3.125
XO	3.5	3.5	2	3.5	
XO	3.5	3.5	2	3.5	3.125
NGB	3.5	1.5	2	3.5	
NGB	3.5	3.5	2	1.5	2.625
1947th	3.5	5.5	2	5.5	4.125
AFDSC	3.5	3.5	2	1.5	
AFDSC	3.5	3.5	2	5.5	3.125
SAF	3.5	-	-	5.5	4.500

Second Level of Analysis

The second level of analysis is based upon the responses (listed in Table VII) to Questions 2 through 5 of the ASIMS interview guide/questionnaire. As described in Chapter 3, the responses for a given directorate or division are averaged to provide an overall growth stage. Table IX lists the numerical values assigned to each response for the Advisory Group and

the ISA Working Group members interviewed. A summary chart (Figure 9) depicts the overall growth stage for each of the 18 Air Staff units studied in the second level of analysis. A wide range of growth stages is depicted in Figure 9, reflecting the varied degrees of data processing evolution at the Air Staff. A summary chart reveals that one-half of the individual directorates or divisions fall between stage 3 and stage 4. This grouping of units further supports the results of the first level of analysis.

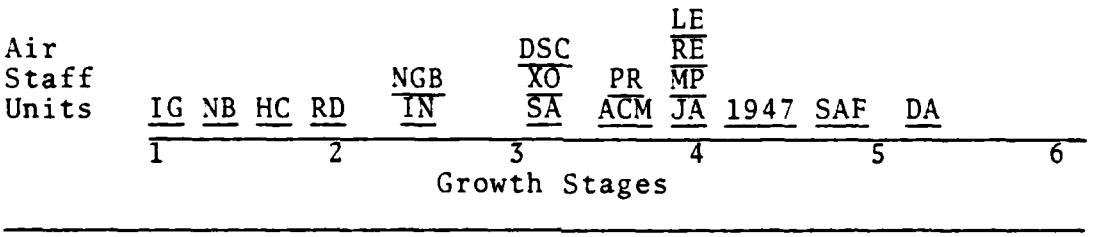


Fig 9. Second Level Analysis: Unit Overall Growth Stage

Organizational Emphasis

Management techniques applied in organizations play an important role in the amount of learning and growth that takes place. Management should provide an environment in which the appropriate changes can take place for the organization to progress from stage to stage. As discussed in Chapter 2, Nolan referred to the two environments of organizational emphasis that guide an organization in its growth. The two environmental factors, innovation and control, must be delicately balanced to allow for evolution through the stages of

data processing.

The results from the first level of analysis, coupled with the guidance in Table II, indicate the appropriate innovation and control for the Air Staff at present. By being in stage 4, the Air Staff should emphasize high innovation and low control. The objective of this organizational emphasis is to remove management control on the use of data and allow users to be innovative. This approach will facilitate the user's knowledge and use of data base systems.

The overall Air Staff organizational emphasis of high innovation and low control may not be applicable to all of its units. The optimal emphasis must consider the growth stage of the unit as shown in Figure 9. Units in stages 1, 2, or entering 3, emphasize the use and control of the computer. During stage 3 and continuing through stage 6, units shift emphasis to managing data rather than concentrating on management of the computer. The combination of the Organizational Summary in Table IX with the Optimum Balance of Organizational Innovation and Control in Table II determines the Unit Optimal Organizational Emphasis as shown in Table X. Table X can be a guide for modifying the overall Air Staff emphasis to fit the growth stage of its individual units.

For units that are in stage 3, innovation and control apply to both the computer and data. Stage 3 is the transition point from managing the computer to managing the data, and requires unique combinations of innovation and control as depicted in Table X.

TABLE X

Unit Optimal Organizational Emphasis

Unit	Overall Growth Stage	Innovation		Control	
		High	Low	High	Low
ACM	3.375		C&D	C	D
DA	5.375		D	D	
HC	1.625		C		C
IG	1.000		C		C
IN	2.625	C			C
JA	3.875		C&D	C	D
LE	3.927		C&D	C	D
MP	3.875		C&D	C	D
NB	1.500		C		C
PR	3.375		C&D	C	D
RD	2.125	C			C
RE	3.625		C&D	C	D
SA	3.125		C&D	C	D
XO	3.125		C&D	C	D
NGB	2.625	C			C
1947th	4.125	D			D
AFDSC	3.125		C&D	C	D
SAF	4.500	D			D

C - Computer D - Data

CHAPTER 6

CONCLUSIONS, OBSERVATIONS AND RECOMMENDATIONS

The Air Staff is a complex organization with many and varied data processing functions and information requirements. An Air Staff Information Management System is being developed to satisfy the expanding information requirements of the Air Staff and the OSAF. The results of this research effort should provide insight to the existing data processing function within the Air Staff as a basis for preparing to implement ASIMS. The Conclusions, Observations and Recommendations of this project address the three research objectives and provide insight for the preparation necessary to implement ASIMS.

Conclusions

Three research objectives were proposed as goals for accomplishing this study. The first objective was to modify Nolan's data processing growth model and criteria for a non-profit military organization. Next, apply the modified theory to the overall Air Staff and its major divisions to determine the stage of growth. The third objective was to recommend the organizational emphasis needed to prepare the Air Staff for the implementation of ASIMS.

The following conclusions were based upon the data analysis. First, Nolan's data processing growth stage model can be modified for a nonprofit organization. The modifications are minor and justified by other stage theorists and authorities on nonprofit organizations. Next, by applying the modified criteria, it was determined that the Air Staff is in stage 4, Integration. Stage 4 indicates the Air Staff has progressed from managing the computer to managing data resources. The third conclusion of the research is that the optimal organizational design for the Air Staff is high innovation and low control. High innovation is accomplished by encouraging many new applications programs and committing more computer resources than are absolutely required. Low control is achieved by relaxing controls on data processing applications, while deemphasizing effectiveness and efficiency. Caution should be taken because the overall emphasis may need to be modified for each unit within the organization. Since the Air Staff is composed of units in stages of growth from 1 to 6, each unit will require a particular combination of innovation and control.

Observations

Several observations were made during the research that will impact the implementation of ASIMS. Many of the personnel interviewed stated that security was a major obstacle to automated data processing growth (4; 20; 27). The lack of adequate secure hardware prevented the automation of routine

classified tasks throughout the Air Staff. The proper security is essential for Air Staff operations, but the slow development of this technology and its incorporation into ASIMS could adversely impact the cost and/or schedule of ASIMS.

Those interviewed also indicated that only a small portion of the potential data processing applications were being used. In other words, the Air Staff has automated some complex applications, but could automate many more functions. Some respondents indicated only 10 to 15 percent of the possible applications are automated (20; 27). Consequently, the users of automated processing foresee a need for many more applications. The recommended organizational design encourages developing many more applications. Therefore, ASIMS must anticipate a significantly larger number of users and applications than currently exist.

The final observation was made while collecting the second level of analysis data. Several Air Staff members interpreted the data gathering questions differently than anticipated. The question content was clarified during the interviews so that answers were based on like interpretations. The unanticipated ambiguity in the data collection instrument is a potential area of concern for future researchers.

Recommendations

The overall goal of ASIMS is to provide timely, accurate, and consistent information for Air Staff and Office of the Secretary of the Air Force problem-solving and decision-

making (7:11). To gain efficiencies and economies in information processing, the Air Staff must promote the evolution of data processing. Nolan offers a six-stage theory that depicts the evolution of data processing and provides guidance for remaining on the growth path. Nolan's model successfully portrays various profit organizations, which with minor modifications is applied to the Air Staff. The analysis concluded the overall Air Staff is in stage 4 and revealed a wide spectrum of existing data processing growth at the Air Staff. To attain the goals of ASIMS, every effort should be made to advance the deficient units so when ASIMS is implemented all units can take full advantage of the system's capabilities. The recommended unit emphasis displayed in Table X provides the best guide for the Air Staff at the present time.

Besides the above general recommendations, the following specific suggestions will prepare the Air Staff for the implementation of ASIMS:

1. The Air Staff conduct an annual review of its data processing growth using Nolan's modified model.
2. Revise the interview guide/questionnaire to reflect the data processing terminology used within the Air Staff to remove ambiguity.
3. The ASIMS Executive Committee review the yearly analysis and specify appropriate guidance in terms of organizational and unit innovation and control.
4. Develop a functional model of the Air Staff. Functional modeling defines the tasks and

relationships of the Air Staff members and the Air Staff units.

5. The ISA Working Group continue making a detailed information flow analysis and then develop an information model from the findings.
6. Use the functional model and information model to design and implement ASIMS.

The research accomplished in this thesis, combined with future efforts, will help the Air Staff Information Management System to provide timely, accurate, and consistent information for Air Force problem-solving and decision-making.

APPENDIX A

ASIMS INTERVIEW GUIDE/QUESTIONNAIRE

DEPARTMENT OF THE AIR FORCE
AIR FORCE INSTITUTE OF TECHNOLOGY (ATC)
WRIGHT-PATTERSON AIR FORCE BASE, OH 45433

19 MAY 1982

REPLY TO ATTN OF: LS (Major Ronald H. Rasch, AUTOVON 785-4549/Commercial (513) 255-4549)

SUBJECT: Air Staff Information Management System

TO: HQ USAF/CVAD(S) (Lt Col Arlyn Schumaker)

1. The Air Force Institute of Technology (AFIT) is currently involved with the Air Staff concerning the implementation of effective information systems. In response to a request from the Office of Information Resource Management, AFIT has agreed to conduct relevant research regarding the Air Staff Information Management System (ASIMS).

2. Two master's degree candidates in the Systems Management Program at AFIT (Captains Larry G. Radov and Stanley A. Sneegas) are conducting thesis research under the guidance of the AFIT graduate faculty (Major Ronald H. Rasch). They have defined a research objective which will determine the current state of data processing growth within the Air Staff. Based on this objective, they will be able to provide recommendations regarding current and future actions concerning the management of ASIMS.

3. To achieve the stated objective, Captains Radov and Sneegas require information concerning the relationship between the data/information processing budget and total Air Staff budget for the past 15 years. They also require your expertise with regard to determining the present level of computer processing technology at the Air Staff, as indicated in Question 1 of the attached questionnaire. Further, they request that each member of the Information Systems Architecture (ISA) Working Group provide information regarding present level of computer processing technology, types of data processing applications, organization, planning and control, and user awareness within their respective organization. These areas are addressed in Questions 1 through 5 of the attached questionnaire.

4. Captains Radov and Sneegas will be at the Pentagon from 14-16 June to discuss the above subjects with members of the ISA Working Group. Your cooperation in this important research project is essential to its completion and your responses will be held confidential. Your views are essential to avoid misleading conclusions.

JEROME G. PETTERS, JR.
Acting Dean
School of Systems and Logistics

1 Atch
Questionnaire

ASIMS INTERVIEW GUIDE/QUESTIONNAIRE

1) Select the state of technology in data/information processing that most closely corresponds to the current situation in your organization or the Air Staff/OSAF as applicable.

A. 100% batch processing.

B. 80% batch processing and
20% remote job entry processing.

C. 70% batch processing,
15% data base processing,
10% inquiry processing, and
5% time-sharing processing.

D. 50% batch and remote job entry processing,
40% data base and data communications processing,
5% personal computing, and
5% minicomputer and microcomputer processing.

E. 20% batch and remote job entry processing,
60% data base and data communications processing,
5% personal computing, and
15% minicomputer and microcomputer processing.

F. 10% batch and remote job entry processing,
60% data base and data communications processing,
5% personal computing, and
25% minicomputer and microcomputer processing.

G. Other, please explain:

2) Select the types of data processing applications/systems that most closely represent your organization at the present time.

A. There is a concentration on labor intensive automation, scientific support, and clerical replacement.

B. Data processing applications/systems are beginning to move out to user locations for data generation and data use.

C. Balance is established between centralized shared data/common systems applications and decentralized user-controlled applications.

3) Concerning the data/information processing organization in your unit, which response is most accurate.

   A. Data processing is centralized and operates as a closed shop.

   B. The data processing organization is the data custodian. Computer utility is established and reliable.

   C. There is an organizational implementation of the data/information resource management concept.

4) Your organization's data processing planning and control is best represented by:

   A. Internal planning and control is installed to manage the computer. Included are standards for programming, responsibility accounting, and project management.

   B. External planning and control is installed to manage data resources. Included are value-added user chargeback, a steering committee, and data administration.

5) The user awareness of data processing systems in your organization is most accurately described by:

   A. Reactive: The end user is superficially involved. The computer provides more, better, and faster information than manual techniques.

   B. Driving Force: The end user is directly involved with data entry and data use. The end user is accountable for data quality and for value-added end use.

   C. Participatory: The end user and data processing are jointly accountable for data quality and for effective design of value-added applications.

6) Please provide any additional comments you have on the above questions and responses.

APPENDIX B

AIR STAFF DATA PROCESSING BUDGET

COMPONENTS OF THE

AIR STAFF DATA PROCESSING BUDGET

Fiscal Years	Procurement	Operations & Maintenance	Personnel	Total
1977	$ 189	$12,966	$2,888	$16,043
1978	$8,428	$11,580	$3,620	$23,628
1979	$ -	$15,820	$4,131	$19,951
1980	$ -	$17,119	$4,539	$21,658
1981	$4,389	$18,621	$6,599	$29,609
1982*	$3,064	$25,257	$7,567	$35,888
1983	$7,834	$30,720	$8,199	$46,753

*Estimates

All $ in Thousands

DEPARTMENT OF THE
AIR FORCE

JUSTIFICATION OF ESTIMATES FOR FISCAL YEARS

1979 - 1983

OPERATIONS AND MAINTENANCE, AIR FORCE

VOLUME II

57

Computer Systems Program (Part I)
(Dollars in Thousands)

Major Systems/Appropriations

Air Staff And OSD Support

Description: This system represents the function of the Air Force Data Services Center in providing required data processing support to the Air Force Staff and Office, Secretary of Defense for all functional areas.

Resources:	FY 1977 Actual	FY 1978 Estimate	FY 1979 Estimate
O&M	$12,966	$13,865	$17,951
RDT&E			
PROCUREMENT	189	8,628	170
TOTAL	$13,155	$22,493	$18,121

Major Changes: The increase in O&M from FY 78 to 79 is required for full year funding of an additional computer system installed in FY 78, contractual networking and information retrieval services and contractual assistance for MULTICS security and systems analyst support.

Computer Systems Program (Part I)
(Dollars in Thousands)

Major Systems/Appropriations

Air Staff And OSD Support

Description: This system represents the function of the Air Force Data Services Center in providing required data processing support to the Air Force Staff and Office, Secretary of Defense for all functional areas.

Resources:	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate
O&M	$11,580	$16,358	$23,230
RDT&E	-	-	-
PROCUREMENT	8,428	-	4,648
TOTAL	$20,008	$16,358	$27,878

Major Changes:

O&M - Increase is for rental of replacement equipment for the GE 635 unclassified time sharing system and enhancement/upgrade of the HON H6080 Multiplexed Information and Computing Service (MULTICS) required to maintain both security and customer response time in support of increased requirements for classified processing by HQ USAF and OSD.

PROCUREMENT - Funds are for the purchase of two CPUs to enhance MULTICS, the Honeywell Page Printer, minicomputers, Graphic Data Terminals and IBM 360/75 peripherals.

Computer Systems Program (Part I)
(Dollars in Thousands)

Major Systems/Appropriations

Air Staff and OSD Support

Description: This system represents the function of the Air Force Data Services Center in providing required data processing support to the Air Force Staff and Office, Secretary of Defense for all functional areas.

Resources:

	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate
O&M	$15,820	$ 21,908	$ 21,302
RDT&E	-	-	-
PROCUREMENT	-	4,648	5,055
TOTAL	$15,820	$ 26,556	$ 26,357

Major Changes:

O&M - Decreases included: reduction in rental due to purchase of installed system C/I replacements and other equipment identified below; reduction due to completion of major portion of software conversion for replacements for Honeywell G635 (System C) and IBM 360/75 (System I) installed in FY 80; reduction due to completion of Networking Contractual Services and Information Retrieval, and a reduced level of FEDSIM Computer Performance Evaluation support.

PROCUREMENT - Purchase of replacements of Honeywell G635 (System C) and IBM 360/75 (System I) which consist of four new computers for a distributed mainframe. Purchase of Honeywell 68/80 System Tape Drives, Interactive Remote Terminals, a Text Processing System, Computer Performance Tools for IBM 360/370 Systems and MULTICS Inter-Office Bridge (IOB).

Computer Systems Program (Part I)
(Dollars in Thousands)

Major Systems/Appropriations

Air Staff and OSD Support

Description: This system represents the function of the Air Force Data Services Center in providing required data processing support to the Air Force Staff and Office, Secretary of Defense for all functional areas.

Resources:

	FY 1980 Actual	FY 1981 Estimate	FY 1982 Estimate
O&M	$17,183	$ 24,212	$ 26,236
PROCUREMENT	-	4,555	3,064
TOTAL	$17,183	$ 28,767	$ 29,300

Major Changes:

O&M - Increases due to maintenance of additional CPU and peripherals to be purchased in FY 82, and contractor service support for the recompetition of the IBM 3032, and construction funds for secure remote sites for HQ USAF Air Staff and OSD customers.

PROCUREMENT - Purchase of additional CPU's for System C (GE 635) and System I (IBM 360/75) replacement, Page Printing Systems, Multics Distributed Processors, and various peripherals.

Computer Systems Program (Part I)
(Dollars in Thousands)

Major Systems/Appropriations

Air Staff and OSD Support

Description: This system represents the function of the Air Force Data Services Center in providing required data processing support to the Air Force Staff and Office, Secretary of Defense for all functional areas.

Resources:

	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate
O&M	$18,621	$25,257	$30,720
PROCUREMENT	4,389	3,064	7,834
TOTAL	$23,010	$28,321	$38,554

Major Changes:

O&M - Primary increase is in contract services for systems and analysis support for installation of an information management system for HQ USAF (DCS/Plans and Operations); additional funding for MULTICS unbundled software; AUTODIN on-line interface and related software; contract support to convert the USAF Program Aerospace Vehicles and Flying Hours System from batch to interactive environment; development support for the Design and Construction Management System and computer performance evaluation studies. Maintenance increase reflects full year maintenance on FY 82 purchases plus FY 83 programmed purchase such as: terminals for text processing and records management, Page Printing System and Performance Data Measurement System.

PROCUREMENT - The FY 83 procurement program includes the acquisition of interactive Cathode Ray Tube (CRT) terminals to support the Air Force staff and OSD users; purchase of two Honeywell DPS 8/70 Central Processing Units for the processing of unclassified requirements; upgrade AUTODIN process by acquisition of hardware to automate transfer of data; acquisition of hardware to create a Network Control Center to automatically monitor circuits; hardware for the development of a Performance Data Measurement System to permit early recognition of problems and hardware acquisition for a text processing system.

APPENDIX C

TOTAL AIR STAFF BUDGET

The total Air Staff budget data includes all of the data in Appendix B. The remaining data comes from:

1. Appropriations 3400 (O&M) and 3080 (Base Procurement) for FY 77 through FY 81 actual was based on the 30 September certified obligation position.
2. The FY 82 and FY 83 O&M budget estimate was developed using the FY 83 Financial Plan submitted by the Air Staff on 19 May 1982.
3. Appropriation 3500 Military Personnel cost was developed on the basis of approved authorization for the Management Headquarters. Approved military personnel standard rates were used.

COMPONENTS OF THE

TOTAL AIR STAFF BUDGET

Fiscal Years	Procurement	Operations & Maintenance	Personnel	Total
1977	$ 932	$65,049	$65,772	$128,753
1978	$9,554	$58,521	$61,086	$129,161
1979	$ 949	$54,613	$60,328	$115,890
1980	$1,067	$57,400	$65,090	$123,557
1981	$5,343	$65,478	$78,650	$149,471
1982*	$4,284	$73,673	$90,248	$168,205
1983*	$8,834	$82,085	$90,880	$181,799

*Estimates

All $ in Thousands

DEPARTMENT OF THE AIR FORCE
PRESIDENT'S BUDGET
ADP TOTAL COST SUMMARY, FY1979
(DOLLARS IN THOUSANDS)

AS OF 06 JAN 1978

AF95 63

REPORT LINE	ENTRY TITLE	FY-77	FY-78	FY-79	FY-80	FY-81	FY-82	FY-83
1.	TOTAL NUMBER OF ADP UNITS							
2A.	IN-HOUSE PERSONNEL RESOURCES - TOTAL MAN YEARS	500	503	505	505	505	505	505
2B.	IN-HOUSE PERSONNEL RESOURCES - TOTAL END STRENGTH	495	504	505	505	505	505	505
3A.	A. CIVILIAN MAN YEARS	259	258	259	259	259	259	259
3B.	CIVILIAN END STRENGTHS	257	259	259	259	259	259	259
4A.	B. MILITARY MAN YEARS	241	242	246	246	246	246	246
4B.	MILITARY END STRENGTHS	239	245	246	246	246	246	246
5A.	C. (MEMO) CIV MAN YEARS - LOCAL ANAL/PROG	154	153	154	154	154	154	154
5B.	(MEMO) CIV END STRENGTHS - LOCAL ANAL/PROG	153	154	154	154	154	154	154
6A.	D. (MEMO) MIL MAN YEARS - LOCAL ANAL/PROG	135	135	137	137	137	136	135
6B.	(MEMO) MIL END STRENGTH - LOCAL ANAL/PROG	134	137	137	137	137	135	135
7.	CAPITAL INVESTMENTS - TOTAL	849	8863	814	745	835	1118	1118
8.	A. PURCHASE OF NEW ADPE		8629		368	458	725	725
9.	B. PURCHASE OF LEASED ADPE	189			76	78	78	78
10.	C. PURCHASE OF OTHER EQUIPMENT	10	15	15	15	15	15	15
11.	D. SITE PREPARATION	650	225	300	330	300	300	300
12.	IN-HOUSE OPERATIONS - TOTAL	8214	8510	8763	8753	8753	8753	8753
13.	A. CIVILIAN SALARIES AND OVERTIME	4423	4715	4766	4706	4706	4706	4766
14.	B. MILITARY BASE PAY AND ALLOWANCES	2848	3055	3162	3108	3108	3108	3108
15.	C. SUPPLIES	903	740	955	939	939	939	939
16.	D. OTHER							
17.	COMMERCIAL CONTRACT SERVICES - TOTAL	8925	9716	14225	13410	15938	17886	17287
18.	A. LEASED ADPE RENTALS AND MAINTENANCE	6642	7634	9416	9263	12212	13338	13433
19.	B. ADPE TIME	497	637	697	442	597	602	602
20.	C. SYSTEMS ANALYSIS AND PROGRAMMING	1198	1164	1502	996	936	936	936
21.	D. MAINTENANCE OF OWNED ADPE	588	647	1337	1246	1040	1045	1161
22.	E. OTHER		260	1345	1195	1195	1245	1195
23.	INTER AND INTRA AGENCY SERVICES	1945-	1541-	2040-	2090-	2130-	2080-	2130-
24.	A. PAYMENTS TO OTHER	20	150	170	170	120	170	120
25.	B. REIMBURSEMENT FROM OTHERS	1965	1691	2250	2258	2250	2250	2250
26.	TOTAL COST	16043	25548	21223	20828	23388	24869	24948
27.	TOTAL COST BY APPROPRIATION							
	AIRCRAFT PROCUREMENT 3010							
	MISSILE PROCUREMENT 3020							
	OTHER PROCUREMENT 3080	149	8628	170	430	528	795	795
	MILITARY CONSTRUCTION 3300							
	OP AND MAINT AF 3400	12966	13865	17951	17290	19760	20966	21037
	MILITARY PERS, AF 3500	2948	3055	3102	3108	3108	3108	3108
	OTHER 3600							
	RESERVE PERS, AF 3730							
	OP AND MAINT AFR 3740							
	OP AND MAINT ANG 3840							
28.	TOTAL COST FOR DEVELOPMENTAL SYSTEMS							
29.	TOTAL COST FOR OPERATIONAL SYSTEMS	16043	25548	21223	20828	23388	24869	24948
30.	TELECOMMUNICATIONS (MEMO)	$	$	$	$	$	$	$

NUMBER AND NAME OF DATA SYSTEM 63 AIR STAFF + OSD SUPPORT

DEPARTMENT OF THE AIR FORCE
PRESIDENT'S BUDGET
ADP TOTAL COST SUMMARY, FY1980 AS OF 16 JAN 1979
ADPS A1 (DOLLARS IN THOUSANDS)

REPORT LINE	ENTRY TITLE	FY-78	FY-79	FY-80	FY-81	FY-82	FY-83
1.	TOTAL NUMBER OF ADP UNITS						
2A.	IN-HOUSE PERSONNEL RESOURCES - TOTAL MAN YEARS	572	572	598	623	623	623
2B.	IN-HOUSE PERSONNEL RESOURCES - TOTAL END STRENGTH	578	583	623	623	623	623
3A.	A. CIVILIAN MAN YEARS	286	289	286	286	286	286
3B.	CIVILIAN END STRENGTHS	244	246	286	246	246	286
4A.	B. MILITARY MAN YEARS	286	287	312	337	337	337
4B.	MILITARY END STRENGTHS	286	287	337	337	337	337
5A.	C. (MEMO) CIV MAN-YEARS - LOCAL ANAL/PROG	175	174	175	175	175	175
5B.	(MEMO) CIV END STRENGTHS - LOCAL ANAL/PROG	174	175	174	175	175	175
6A.	D. (MEMO) MIL MAN YEARS - LOCAL ANAL/PROG	197	197	192	217	216	215
6B.	(MEMO) MIL END STRENGTH - LOCAL ANAL/PROG	167	167	217	217	215	215
7.	CAPITAL INVESTMENTS - TOTAL	1790	390	4979	891	1120	2291
8.	A. PURCHASE OF NEW ADPE			1498	458	725	725
9.	B. PURCHASE OF LEASED ADPE	1620		3150	70	70	70
10.	C. PURCHASE OF OTHER EQUIPMENT	11	20	24	24	24	24
11.	D. SITE PREPARATION	311	330	307	307	307	1472
12.	IN-HOUSE OPERATIONS - TOTAL	9591	10004	10511	10445	10445	10445
13.	A. CIVILIAN SALARIES AND OVERTIME	5241	5489	5981	5981	5981	5981
14.	B. MILITARY PAY AND ALLOWANCES	3620	3824	4175	4589	4589	4589
15.	C. SUPPLIES	730	779	779	779	779	779
16.	D. OTHER						
17.	COMMERCIAL CONTRACT SERVICES - TOTAL	9917	14302	20049	29290	20749	21720
18.	A. LEASED ADPE RENTALS AND MAINTENANCE	5618	10842	13282	14769	15939	16059
19.	B. ADPE TIME	877	714	788	2749	768	788
20.	C. SYSTEMS ANALYSIS AND PROGRAMMING	1864	718	3831	4797	1489	1489
21.	D. MAINTENANCE OF OWNED ADPE	1420	1349	1984	1999	1269	1288
22.	E. OTHER	746	1548	1944	1396	1292	1348
23.	INTER AND INTRA AGENCY SERVICES	-4230-	-4414-	-4242-	-4290-	-4407-	-4391-
24.	A. PAYMENTS TO OTHER	65	136	220	220	114	170
25.	B. REIMBURSEMENT FROM OTHERS	4295	4778	4982	4910	4921	4921
26.	TOTAL COST	23620	28182	32853	32654	28313	30589
27.	TOTAL COST BY APPROPRIATION						
	AIRCRAFT PROCUREMENT 3010						
	MISSILE PROCUREMENT 3020						
	OTHER PROCUREMENT 3080	8428		4648	520	795	795
	MILITARY CONSTRUCTION 3300						1169
	OP AND MAINT AF 3400	11598	14158	23238	27629	23089	24036
	MILITARY PERS, AF 3500	3620	3824	4175	4589	4589	4589
	ANG&E 3600						
	RESERVE PERS, AF 3700						
	OP AND MAINT AFR 3740						
	OP AND MAINT ANG 3840						
28.	TOTAL COST FOR DEVELOPMENTAL SYSTEMS						
29.	TOTAL COST FOR OPERATIONAL SYSTEMS	23620	28182	32853	32654	28313	30589
30.	TELECOMMUNICATIONS (MEMO)	73	166	166	166	166	166

NUMBER AND NAME OF DATA SYSTEM 61 AIR STAFF + OSD SUPPORT

DEPARTMENT OF THE AIR FORCE
PRESIDENT'S BUDGET

ADPS 63 — ADP TOTAL COST SUMMARY (FY1984) — (DOLLARS IN THOUSANDS) — AS OF 14 MAR 1980

REPORT LINE	ENTRY TITLE	FY-79	FY-80	FY-81	FY-82	FY-83
1.	TOTAL NUMBER OF ADP UNITS					
2A.	IN-HOUSE PERSONNEL RESOURCES - TOTAL MAN YEARS	581	606	648	668	654
2B.	IN-HOUSE PERSONNEL RESOURCES - TOTAL END STRENGTH	581	630	666	654	654
3A.	A. CIVILIAN MAN YEARS	274	273	269	266	266
3B.	CIVILIAN END STRENGTHS	274	271	266	266	266
4A.	B. MILITARY MAN YEARS	307	333	380	394	388
4B.	MILITARY END STRENGTHS	307	359	400	388	388
5A.	C. (DEMO) CIV MAN YEARS - LOCAL ANAL/PROG	171	171	170	170	170
5B.	(DEMO) CIV END STRENGTHS - LOCAL ANAL/PROG	171	170	170	170	170
6A.	D. (DEMO) MIL MAN YEARS - LOCAL ANAL/PROG	189	214	254	263	257
6B.	(DEMO) MIL END STRENGTH - LOCAL ANAL/PROG	189	239	269	257	257
7.	CAPITAL INVESTMENTS - TOTAL	329	3194	9881	2501	8881
8.	A. PURCHASE OF NEW ADPE		1510	5855	1765	1365
9.	B. PURCHASE OF LEASED ADPE		3136		70	70
10.	C. PURCHASE OF OTHER EQUIPMENT	44	24	24	24	24
11.	D. SITE PREPARATION	285	522	722	722	1072
12.	IN-HOUSE OPERATIONS - TOTAL	18557	11668	12301	12459	12372
13.	A. CIVILIAN SALARIES AND OVERTIME	9843	5787	5618	5566	5566
14.	B. MILITARY BASE PAY AND ALLOWANCES	4151	4762	5583	5713	5626
15.	C. SUPPLIES	1883	1180	1180	1180	1180
16.	D. OTHER					
17.	COMMERCIAL CONTRACT SERVICES - TOTAL	13358	19574	19167	18733	18953
18.	A. LEASED ADPE RENTALS AND MAINTENANCE	6408	13306	12588	12565	13036
19.	B. ADPE TIME	639	856	866	841	841
20.	C. SYSTEMS ANALYSIS AND PROGRAMMING	1368	1129	2313	1983	2083
21.	D. MAINTENANCE OF OWNED ADPE	1348	1660	2238	2248	1895
22.	E. OTHER	1421	1540	1170	1170	1170
23.	INTER AND INTRA AGENCY SERVICES	4289-	5124-	5489-	5489-	5399-
24.	A. PAYMENTS TO OTHER	283	50	75	75	75
25.	B. REIMBURSEMENT FROM OTHERS	4572	5174	5564	5564	5474
26.	TOTAL COST	19951	31317	31868	28364	29257
27.	TOTAL COST BY APPROPRIATION					
	AIRCRAFT PROCUREMENT 3010					
	MISSILE PROCUREMENT 3020					
	OTHER PROCUREMENT 3080		6648	5855	1835	1435
	MILITARY CONSTRUCTION 3300					1165
	OP AND MAINT AF 3400	15078	21908	21382	20816	21031
	MILITARY PERS, AF 3500	4151	4762	5583	5713	5626
	RDT&E 3600					
	RESERVE PERS, AF 3700					
	OP AND MAINT ARF 3740					
	OP AND MAINT ANG 3840					
	TOTAL COST FOR DEVELOPMENTAL SYSTEMS					
	TOTAL COST FOR OPERATIONAL SYSTEMS	19951	31317	31868	28364	29257
	TELECOMMUNICATIONS (MEMO)	166	166	166	166	166

NUMBER AND NAME OF DATA SYSTEM 63 AIR STAFF + OSD SUPPORT

DEPARTMENT OF THE AIR FORCE
PRESIDENT'S BUDGET
ADP TOTAL COST SUMMARY, FY1982 AS OF 02 FEB 1981
(DOLLARS IN THOUSANDS)

ADPS 63

REPORT LINE	ENTRY TITLE	FY-80	FY-81	FY-82	FY-83
1.	TOTAL NUMBER OF ADP UNITS				
2A.	IN-HOUSE PERSONNEL RESOURCES - TOTAL MAN YEARS	601	623	636	632
2B.	IN-HOUSE PERSONNEL RESOURCES - TOTAL END STRENGTH	601	644	632	632
3A.	A. CIVILIAN MAN YEARS	263	252	260	260
3B.	CIVILIAN END STRENGTHS	263	260	260	260
4A.	B. MILITARY MAN YEARS	338	361	376	372
4B.	MILITARY END STRENGTHS	338	384	372	372
5A.	C. (MEMO) CIV MAN YEARS - LOCAL ANAL/PROG	98	98	95	95
5B.	(MEMO) CIV END STRENGTHS - LOCAL ANAL/PROG	98	95	95	95
6A.	D. (MEMO) MIL MAN YEARS - LOCAL ANAL/PROG	167	167	163	160
6B.	(MEMO) MIL END STRENGTH - LOCAL ANAL/PROG	167	166	160	160
7.	CAPITAL INVESTMENTS - TOTAL	700	5408	4064	2180
8.	A. PURCHASE OF NEW ADPE		2855	2764	965
9.	B. PURCHASE OF LEASED ADPE		1700	300	100
10.	C. PURCHASE OF OTHER EQUIPMENT	500	154	180	204
11.	D. SITE PREPARATION	200	700	800	911
12.	IN-HOUSE OPERATIONS - TOTAL	11058	12696	13065	13063
13.	A. CIVILIAN SALARIES AND OVERTIME	6646	6008	5980	5980
14.	B. MILITARY BASE PAY AND ALLOWANCES	4039	5597	5887	5784
15.	C. SUPPLIES	374	1088	1198	1288
16.	D. OTHER				
17.	COMMERCIAL CONTRACT SERVICES - TOTAL	12426	19031	21179	22606
18.	A. LEASED ADPE RENTALS AND MAINTENANCE	10662	13664	16018	15473
19.	B. ADPE TIME		270	285	310
20.	C. SYSTEMS ANALYSIS AND PROGRAMMING		1902	1293	2860
21.	D. MAINTENANCE OF OWNED ADPE	1763	2210	2448	2658
22.	E. OTHER		985	1135	1305
23.	INTER AND INTRA AGENCY SERVICES	2826-	2805-	3181-	3421-
24.	A. PAYMENTS TO OTHER	78	28	28	30
25.	B. REIMBURSEMENT FROM OTHERS	2600	2830	3209	3451
26.	TOTAL COST	21656	34330	36117	34427
27.	TOTAL COST BY APPROPRIATION				
	AIRCRAFT PROCUREMENT 3010				
	MISSILE PROCUREMENT 3020				
	OTHER PROCUREMENT 3080		4555	3064	1065
	MILITARY CONSTRUCTION 3300				
	OP AND MAINT AF 3400	17118	24177	26166	27566
	MILITARY PERS, AF 3500	4638	5597	5887	5784
	RDT&E 3600				
	RESERVE PERS, AF 3700				
	OP AND MAINT AFR 3740				
	OP AND MAINT ANG 3840				
28.	TOTAL COST FOR DEVELOPMENTAL SYSTEMS				
29.	TOTAL COST FOR OPERATIONAL SYSTEMS	21656	34330	36117	34427
30.	TELECOMMUNICATIONS (MEMO)	5	5	5	5

NUMBER AND NAME OF DATA SYSTEM 63 AIR STAFF + OSD SUPPORT

AS OF 31 JAN 1982

DEPARTMENT OF THE AIR FORCE
PRESIDENT'S BUDGET
ADP TOTAL COST SUMMARY, FY1983
(DOLLARS IN THOUSANDS)

ADPS 83

REPORT LINE	ENTRY TITLE	FY-81	FY-82	FY-83
1.	TOTAL NUMBER OF ADP UNITS			
2A.	IN-HOUSE PERSONNEL RESOURCES - TOTAL MAN YEARS	658	660	697
2B.	IN-HOUSE PERSONNEL RESOURCES - TOTAL END STRENGTH	658	661	732
3A.	A. CIVILIAN MAN YEARS	258	258	263
3B.	CIVILIAN END STRENGTHS	258	258	266
4A.	B. MILITARY MAN YEARS	400	402	434
4B.	MILITARY END STRENGTHS	400	403	464
5A.	C. (MEMO) CIV MAN YEARS - LOCAL ANAL/PROG	81	81	86
5B.	(MEMO) CIV END STRENGTHS - LOCAL ANAL/PROG	81	81	90
6A.	D. (MEMO) MIL MAN YEARS - LOCAL ANAL/PROG	111	113	142
6B.	(MEMO) MIL END STRENGTH - LOCAL ANAL/PROG	111	114	170
7.	CAPITAL INVESTMENTS - TOTAL	5889	4064	9183
8.	A. PURCHASE OF NEW ADPE	3761	2764	7734
9.	B. PURCHASE OF LEASED ADPE	628	300	100
10.	C. PURCHASE OF OTHER EQUIPMENT	1100	190	204
11.	D. SITE PREPARATION	400	800	1145
12.	IN-HOUSE OPERATIONS - TOTAL	13333	14913	16335
13.	A. CIVILIAN SALARIES AND OVERTIME	5834	6148	6330
14.	B. MILITARY BASE PAY AND ALLOWANCES	6599	7567	8199
15.	C. SUPPLIES	900	1198	1518
16.	D. OTHER			289
17.	COMMERCIAL CONTRACT SERVICES - TOTAL	13692	20102	24656
18.	A. LEASED ADPE RENTALS AND MAINTENANCE	9398	15941	14046
19.	B. ADPE TIME	250	285	310
20.	C. SYSTEMS ANALYSIS AND PROGRAMMING	1298	1285	6809
21.	D. MAINTENANCE OF OWNED ADPE	1663	2443	3186
22.	E. OTHER	966	148	1306
23.	INTER AND INTRA AGENCY SERVICES	3206-	3161-	3421-
24.	A. PAYMENTS TO OTHER	26	28	30
25.	B. REIMBURSEMENT FROM OTHERS	3230	3209	3451
26.	TOTAL COST	29609	35888	46762
27.	TOTAL COST BY APPROPRIATION			
	AIRCRAFT PROCUREMENT 3010			
	MISSILE PROCUREMENT 3020			
	OTHER PROCUREMENT 3080	4389	3064	7834
	MILITARY CONSTRUCTION 3300			
	OP AND MAINT AF 3400	18621	25257	30720
	MILITARY PERS, AF 3500	6599	7567	8199
	RDT&E 3600			
	RESERVE PERS, AF 3700			
	OP AND MAINT AFR 3740			
	OP AND MAINT ANG 3840			
28.	TOTAL COST FOR DEVELOPMENTAL SYSTEMS			
29.	TOTAL COST FOR OPERATIONAL SYSTEMS	29609	35888	46762
30.	TELECOMMUNICATIONS (MEMO)	5	5	5

NUMBER AND NAME OF DATA SYSTEM 83 AIR STAFF + OSD SUPPORT

APPENDIX D

INTERVIEW/QUESTIONNAIRE RESULTS

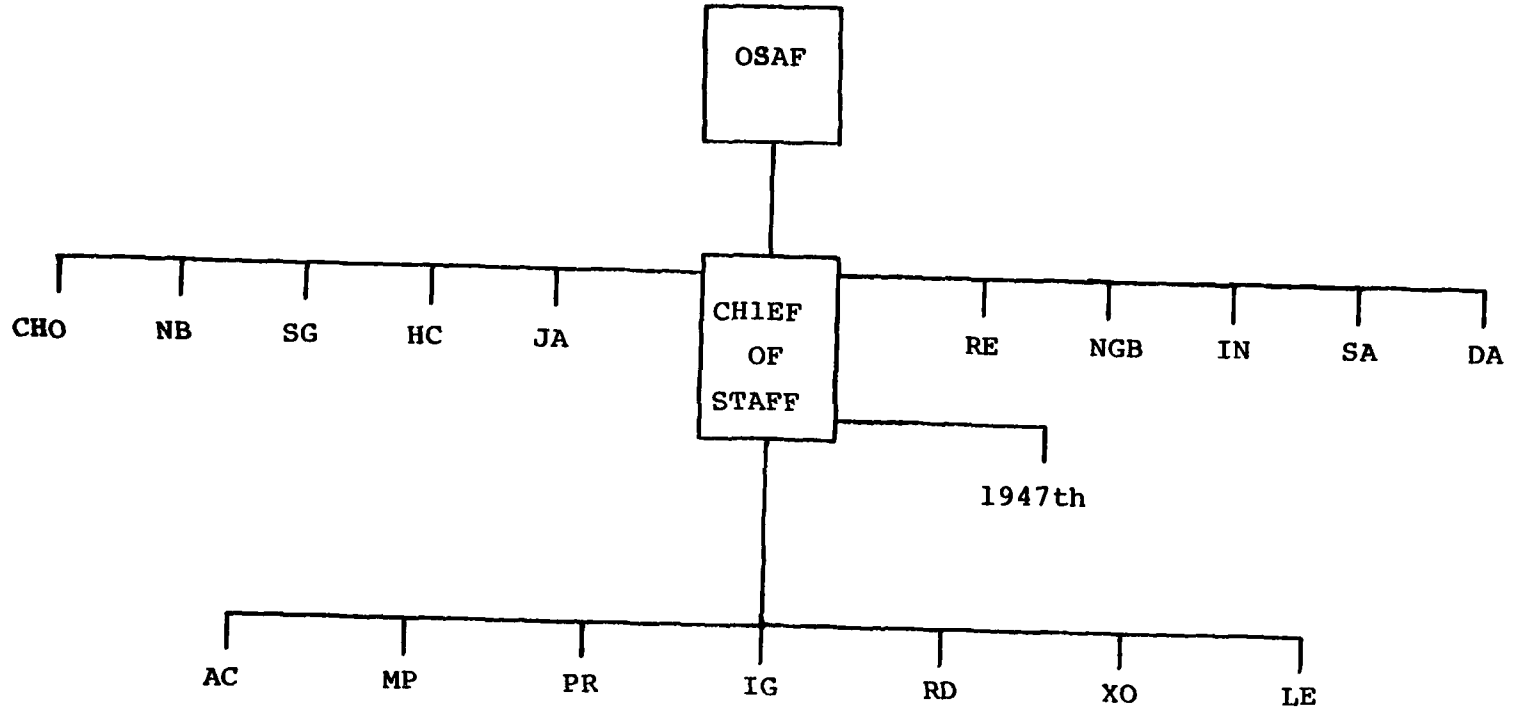
Interview/Questionnaire Results

Respondent	Question Number 1	2	3	4	5
Caswell	D to E				
Petroski	D				
Tufts	D				
ACM		A	B	B	B
ACM		A	B	B	B
DA		C	C	B	C
DA		C	C	B	C
HC		A	A	A	B
HC		A	A	A	B
IG			NO DATA PROCESSING		
IN		B	A	A	C
IN		A	B	A	A
JA		A	B	B	C
LE		C	C	B	C
LE		A	-	-	B
MP		C	C	A	B
MP		B	B	A	C
NB		A	-	-	A
PR		B	C	A	B
PR		B	A	A	C
RD		A	B	A	A
RE		C	B	A	B
SA		A	C	A	B
SA		A	C	A	B
XO		B	B	A	B
XO		B	B	A	B
NGB		B	B	A	A
1947th		B	C	A	C
AFDSC		B	B	A	A
AFDSC		B	B	A	C
OSAF		B	-	-	C

APPENDIX E

AIR STAFF ORGANIZATION CHART

AIR STAFF ORGANIZATIONAL CHART



SELECTED BIBLIOGRAPHY

A. REFERENCES CITED

1. Air Force Ad Hoc Planning Group. "Information Resources Management." Unpublished report, unnumbered, Headquarters Air Force, Washington, 20 November 1980.

2. Albanese, Robert. Managing: Toward Accountability for Performance. 3d ed. Homewood IL: Richard D. Irwin, Inc., 1981.

3. Anthony, Robert N., and Regina E. Herzlinger. Management Control in Nonprofit Organizations. Rev. ed. Homewood IL: Richard D. Irwin, Inc., 1980.

4. Caswell, Lieutenant Colonel William M., USAF. Deputy Director of Air Staff Systems, AFDSC/GL, The Pentagon, Washington. Personal interview. 14 June 1982.

5. Cushing, Barry E. Accounting Information Systems and Business Organizations. 3d ed. Reading MA: Addison-Wesley Publishing Company, 1982.

6. Cyert, R.M., and James G. March. "Organizational Factors in the Theory of Oligopoly," Quarterly Journal of Economics, February 1956, pp. 53-55.

7. Driessnack, Lieutenant General Hans H., USAF. Assistant Vice Chief of Staff. Memorandum for Establishment of The Air Staff Information Management System Project Management Organization. The Pentagon, Washington. 29 October 1981.

8. Galbrath, Jay. Designing Complex Organizations. Reading MA: Addison-Wesley Publishing Company, 1973.

9. Gibson, Cyrus F., and Richard L. Nolan. "Managing the Four Stages of EDP Growth," Harvard Business Review, January-February 1974, pp. 76-88.

10. Gilbert, Albert J. Data Automation Specialist, AF/ACDR, The Pentagon, Washington. Personal interview. 15 June 1982.

11. Head, Robert V. "Federal IRM: Seeking a Path Through the Paperwork Jungle," Infosystems, April 1981, pp. 54-60.

12. Hussain, Donna, and K.M. Hussain. Information Systems for Management. Homewood IL: Richard D. Irwin, Inc., 1981.

13. Landau, Robert M. Information Resources Management. New York: American Management Association, 1980.

14. Nolan, Richard L. "Establishing Management Objectives," Data Base, Summer-Fall 1981, pp. 9-19.

15. _____. "Managing the Crises in Data Processing," Harvard Business Review, March-April 1979, pp. 115-126.

16. Payne, Keith R., Chief, Budget and Programs, 1947 AS/FMCB, The Pentagon, Washington. Personal interview. 17 June 1982.

17. Petroski, Frank. Directorate of Computer Systems Management, AFDSC/CMC, The Pentagon, Washington. Telephone interview. 23 June 1982.

18. Rasch, Major Ronald H., USAF. Assistant Professor of Accounting, Department of Organizational Behavior, AFIT/LS, Wright-Patterson AFB OH. Personal interviews conducted intermittently from 10 November 1981 to 20 August 1982.

19. Schoderbek, Charles G., Peter P. Schoderbek, and Asterios G. Kefalas. Management Systems Conceptual Considerations. Dallas: Business Publications, Inc., 1980.

20. Schumaker, Lieutenant Colonel Arlyn D., USAF. Deputy Director ASIMS Program Office. Air Staff Information Management System Briefing. The Pentagon, Washington, 29 October 1981.

21. _____. Charter for the Air Staff Information Management System(ASIMS) Project Management Office. The Pentagon, Washington, 29 October 1981.

22. _____. Personal interviews conducted intermittently from 7 November 1981 to 7 July 1982.

23. Stone, Eugene F. Research Methods in Organizational Behavior. Santa Monica CA: Goodyear Publishing Company, Inc., 1978.

24. Strassman, Paul A. "Stages of Growth," Datamation, October 1976, pp. 46-50.

25. Synnott, William R., and William H. Gruber. Information Resource Management. New York: John Wiley & Sons, Inc., 1981.

26. Taliaferro, Richard J. "Economic Analysis and Public Policy." Unpublished technical report, LS-4-81, AU-AFIT, Wright-Patterson AFB OH, September 1981.

27. Tufts, Lieutenant Colonel Robert J., USAF. Director of Air Staff Programs and Financial Systems, AFDSC/GK, The Pentagon, Washington. Personal interview. 14 June 1982.

28. U.S. Commission on Federal Paperwork. Final Summary Report. Washington: Government Printing Office, 3 October 1977.

29. _____. Information Resources Management. Washington: Government Printing Office, 9 September 1977.

30. _____. The Federal Information Locator System. Washington: Government Printing Office, 15 July 1977.

31. U.S. Department of the Air Force. Justification of Estimates for Fiscal Year 1979, Volume II. Washington: Government Printing Office, February 1978.

32. _____. Justification of Estimates for Fiscal Year 1980, Volume II. Washington: Government Printing Office, February 1979.

33. _____. Justification of Estimates for Fiscal Year 1981, Volume II. Washington: Government Printing Office, January 1980.

34. _____. Justification of Estimates for Fiscal Year 1982, Volume II. Washington: Government Printing Office, January 1981.

35. _____. Justification of Estimates for Fiscal Year 1983, Volume II. Washington: Government Printing Office, February 1982.

36. _____. President's Budget ADP Total Cost Summary, FY 1979. Washington: Air Force Data Services Center, 6 January 1978.

37. _____. President's Budget ADP Total Cost Summary, FY 1980. Washington: Air Force Data Services Center, 16 January 1979.

38. _____. President's Budget ADP Total Cost Summary, FY 1981. Washington: Air Force Data Services Center, 14 March 1980.

39. _____. President's Budget ADP Total Cost Summary, FY 1982. Washington: Air Force Data Services Center, 2 February 1981.

40. _____. President's Budget ADP Total Cost Summary, FY 1983. Washington: Air Force Data Services Center, 31 January 1982.

41. U.S. Department of Defense. Department of the Air Force Directory. Washington: Government Printing Office, 1 September 1981.

42. Withington, Frederic G. "Five Generations of Computers," Harvard Business Review, July-August 1974, pp. 99-108.

43. Young, Arthur, and Company. The Design of an Information Management Program for Headquarters, Department of the Army, Phase 2 Detailed Report. Washington: Arthur Young and Company, 26 February 1980.